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AERONAUTICS

Includes aeronautics (general); aerodynamics; air transportation and safety; aircraft communications and navigation; aircraft design, testing and performance; aircraft instrumentation; aircraft propulsion and power; aircraft stability and control; and research and support facilities (air).

For related information see also *Astronautics*.

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For related information see also *34 Fluid Mechanics and Heat Transfer.*

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VOLUME 26 NUMBER 10 / MAY 23, 1988

TABLE OF CONTENTS

AERONAUTICS

Includes aeronautics (general); aerodynamics; air transportation and safety; aircraft communications and navigation; aircraft design, testing and performance; aircraft instrumentation; aircraft propulsion and power; aircraft stability and control; and research and support facilities (air).

For related information see also *Astronautics*.

01 AERONAUTICS (GENERAL) **N.A.**

02 AERODYNAMICS **1267**

Includes aerodynamics of bodies, combinations, wings, rotors, and control surfaces; and internal flow in ducts and turbomachinery.

For related information see also *34 Fluid Mechanics and Heat Transfer*

03 AIR TRANSPORTATION AND SAFETY **1273**

Includes passenger and cargo air transport operations; and aircraft accidents.

For related information see also *16 Space Transportation* and *85 Urban Technology and Transportation*.

04 AIRCRAFT COMMUNICATIONS AND NAVIGATION **1276**

Includes digital and voice communication with aircraft; air navigation systems (satellite and ground based); and air traffic control.

For related information see also *17 Space Communications, Spacecraft Communications, Command and Tracking* and *32 Communications and Radar*.

05 AIRCRAFT DESIGN, TESTING AND PERFORMANCE **1276**

Includes aircraft simulation technology.

For related information see also *18 Spacecraft Design, Testing and Performance* and *39 Structural Mechanics*. For land transportation vehicles see *85 Urban Technology and Transportation*.

06 AIRCRAFT INSTRUMENTATION **N.A.**

Includes cockpit and cabin display devices; and flight instruments.

For related information see also *19 Spacecraft Instrumentation* and *35 Instrumentation and Photography*.

07 AIRCRAFT PROPULSION AND POWER **1279**

Includes prime propulsion systems and systems components, e.g., gas turbine engines and compressors; and onboard auxiliary power plants for aircraft.

For related information see also *20 Spacecraft Propulsion and Power, 28 Propellants and Fuels*, and *44 Energy Production and Conversion*.

08 AIRCRAFT STABILITY AND CONTROL **1284**

Includes aircraft handling qualities; piloting; flight controls; and autopilots.

For related information see also *05 Aircraft Design, Testing and Performance*.

09 RESEARCH AND SUPPORT FACILITIES (AIR) **1285**

Includes airports, hangars and runways; aircraft repair and overhaul facilities; wind tunnels; shock tubes; and aircraft engine test stands.

For related information see also *14 Ground Support Systems and Facilities (Space)*.

ASTRONAUTICS

Includes astronautics (general); astrodynamics; ground support systems and facilities (space); launch vehicles and space vehicles; space transportation; space communications, spacecraft communications, command and tracking; spacecraft design, testing and performance; spacecraft instrumentation; and spacecraft propulsion and power.

For related information see also *Aeronautics*

12 ASTRONAUTICS (GENERAL) **1285**

For extraterrestrial exploration see *91 Lunar and Planetary Exploration*.

13 ASTRODYNAMICS **N.A.**

Includes powered and free-flight trajectories; and orbital and launching dynamics.

14 GROUND SUPPORT SYSTEMS AND FACILITIES (SPACE) **1289**

Includes launch complexes, research and production facilities; ground support equipment, e.g., mobile transporters; and simulators.

For related information see also *09 Research and Support Facilities (Air)*.

15 LAUNCH VEHICLES AND SPACE VEHICLES **1290**

Includes boosters; operating problems of launch/space vehicle systems; and reusable vehicles.

For related information see also *20 Spacecraft Propulsion and Power*.

16 SPACE TRANSPORTATION **1290**

Includes passenger and cargo space transportation, e.g., shuttle operations; and space rescue techniques.

For related information see also *03 Air Transportation and Safety* and *18 Spacecraft Design, Testing and Performance*. For space suits see *54 Man/System Technology and Life Support*.

17 SPACE COMMUNICATIONS, SPACECRAFT COMMUNICATIONS, COMMAND AND TRACKING **N.A.**

Includes telemetry; space communications networks; astronavigation and guidance; and radio blackout.

For related information see also *04 Aircraft Communications and Navigation* and *32 Communications and Radar*.

18 SPACECRAFT DESIGN, TESTING AND PERFORMANCE 1291

Includes satellites; space platforms; space stations; spacecraft systems and components such as thermal and environmental controls; and attitude controls.

For life support systems see *54 Man/System Technology and Life Support.* For related information see also *05 Aircraft Design, Testing and Performance, 39 Structural Mechanics,* and *16 Space Transportation.*

19 SPACECRAFT INSTRUMENTATION N.A.

For related information see also *06 Aircraft Instrumentation* and *35 Instrumentation and Photography.*

20 SPACECRAFT PROPULSION AND POWER 1293

Includes main propulsion systems and components, e.g. rocket engines; and spacecraft auxiliary power sources.

For related information see also *07 Aircraft Propulsion and Power, 28 Propellants and Fuels, 44 Energy Production and Conversion,* and *15 Launch Vehicles and Space Vehicles.*

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Includes chemistry and materials (general); composite materials; inorganic and physical chemistry; metallic materials; nonmetallic materials; propellants and fuels; and materials processing.

23 CHEMISTRY AND MATERIALS (GENERAL) N.A.

24 COMPOSITE MATERIALS 1294

Includes physical, chemical, and mechanical properties of laminates and other composite materials.

For ceramic materials see *27 Nonmetallic Materials.*

25 INORGANIC AND PHYSICAL CHEMISTRY 1296

Includes chemical analysis, e.g., chromatography; combustion theory; electrochemistry; and photochemistry.

For related information see also *77 Thermodynamics and Statistical Physics.*

26 METALLIC MATERIALS 1300

Includes physical, chemical, and mechanical properties of metals, e.g., corrosion; and metallurgy.

27 NONMETALLIC MATERIALS 1304

Includes physical, chemical, and mechanical properties of plastics, elastomers, lubricants, polymers, textiles, adhesives, and ceramic materials.

For composite materials see *24 Composite Materials.*

28 PROPELLANTS AND FUELS 1306

Includes rocket propellants, igniters and oxidizers; their storage and handling procedures; and aircraft fuels.

For related information see also *07 Aircraft Propulsion and Power, 20 Spacecraft Propulsion and Power,* and *44 Energy Production and Conversion.*

29 MATERIALS PROCESSING 1307

Includes space-based development of products and processes for commercial application.

For biological materials see *55 Space Biology.*

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Includes engineering (general); communications and radar; electronics and electrical engineering; fluid mechanics and heat transfer; instrumentation and photography; lasers and masers; mechanical engineering; quality assurance and reliability; and structural mechanics.

For related information see also *Physics.*

31 ENGINEERING (GENERAL) 1309

Includes vacuum technology; control engineering; display engineering; cryogenics; and fire prevention.

32 COMMUNICATIONS AND RADAR 1317

Includes radar; land and global communications; communications theory; and optical communications.

For related information see also *04 Aircraft Communications and Navigation* and *17 Space Communications, Spacecraft Communications, Command and Tracking.* For search and rescue see *03 Air Transportation and Safety,* and *16 Space Transportation.*

33 ELECTRONICS AND ELECTRICAL ENGINEERING 1322

Includes test equipment and maintainability; components, e.g., tunnel diodes and transistors; microminiaturization; and integrated circuitry.

For related information see also *60 Computer Operations and Hardware* and *76 Solid-State Physics.*

34 FLUID MECHANICS AND HEAT TRANSFER 1325

Includes boundary layers; hydrodynamics; fluidics; mass transfer and ablation cooling.

For related information see also *02 Aerodynamics* and *77 Thermodynamics and Statistical Physics.*

35 INSTRUMENTATION AND PHOTOGRAPHY 1333

Includes remote sensors; measuring instruments and gages; detectors; cameras and photographic supplies; and holography.

For aerial photography see *43 Earth Resources and Remote Sensing.* For related information see also *06 Aircraft Instrumentation* and *19 Spacecraft Instrumentation.*

36 LASERS AND MASERS 1334

Includes parametric amplifiers.

For related information see also *76 Solid-State Physics.*

37 MECHANICAL ENGINEERING 1338

Includes auxiliary systems (nonpower); machine elements and processes; and mechanical equipment.

38 QUALITY ASSURANCE AND RELIABILITY 1341

Includes product sampling procedures and techniques; and quality control.

39 STRUCTURAL MECHANICS 1342

Includes structural element design and weight analysis; fatigue; and thermal stress.

For applications see *05 Aircraft Design, Testing and Performance* and *18 Spacecraft Design, Testing and Performance.*

GEOSCIENCES

Includes geosciences (general); earth resources and remote sensing; energy production and conversion; environment pollution; geophysics; meteorology and climatology; and oceanography.

For related information see also *Space Sciences.*

42 GEOSCIENCES (GENERAL) **N.A.**

43 EARTH RESOURCES AND REMOTE SENSING **1346**

Includes remote sensing of earth resources by aircraft and spacecraft; photogrammetry; and aerial photography.

For instrumentation see *35 Instrumentation and Photography.*

44 ENERGY PRODUCTION AND CONVERSION **1348**

Includes specific energy conversion systems, e.g., fuel cells; global sources of energy; geophysical conversion; and windpower.

For related information see also *07 Aircraft Propulsion and Power, 20 Spacecraft Propulsion and Power,* and *28 Propellants and Fuels.*

45 ENVIRONMENT POLLUTION **1352**

Includes atmospheric, noise, thermal, and water pollution.

46 GEOPHYSICS **1353**

Includes aeronomy; upper and lower atmosphere studies; ionospheric and magnetospheric physics; and geomagnetism.

For space radiation see *93 Space Radiation.*

47 METEOROLOGY AND CLIMATOLOGY **1355**

Includes weather forecasting and modification.

48 OCEANOGRAPHY **1356**

Includes biological, dynamic, and physical oceanography; and marine resources.

For related information see also *43 Earth Resources and Remote Sensing.*

LIFE SCIENCES

Includes life sciences (general); aerospace medicine; behavioral sciences; man/system technology and life support; and space biology.

51 LIFE SCIENCES (GENERAL) **1359**

52 AEROSPACE MEDICINE **1368**

Includes physiological factors; biological effects of radiation; and effects of weightlessness on man and animals.

53 BEHAVIORAL SCIENCES **1372**

Includes psychological factors; individual and group behavior; crew training and evaluation; and psychiatric research.

54 MAN/SYSTEM TECHNOLOGY AND LIFE SUPPORT **1372**

Includes human engineering; biotechnology; and space suits and protective clothing.

For related information see also *16 Space Transportation.*

55 SPACE BIOLOGY **N.A.**

Includes exobiology; planetary biology; and extraterrestrial life.

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Includes mathematical and computer sciences (general); computer operations and hardware; computer programming and software; computer systems; cybernetics; numerical analysis; statistics and probability; systems analysis; and theoretical mathematics.

59 MATHEMATICAL AND COMPUTER SCIENCES (GENERAL) **N.A.**

60 COMPUTER OPERATIONS AND HARDWARE **1373**

Includes hardware for computer graphics, firmware, and data processing.

For components see *33 Electronics and Electrical Engineering.*

61 COMPUTER PROGRAMMING AND SOFTWARE **1385**

Includes computer programs, routines, algorithms, and specific applications, e.g., CAD/CAM.

62 COMPUTER SYSTEMS **1392**

Includes computer networks and special application computer systems.

63 CYBERNETICS **1393**

Includes feedback and control theory, artificial intelligence, robotics and expert systems.

For related information see also *54 Man/System Technology and Life Support.*

64 NUMERICAL ANALYSIS **1397**

Includes iteration, difference equations, and numerical approximation.

65 STATISTICS AND PROBABILITY **1402**

Includes data sampling and smoothing; Monte Carlo method; and stochastic processes.

66 SYSTEMS ANALYSIS **1403**

Includes mathematical modeling; network analysis; and operations research.

67 THEORETICAL MATHEMATICS **1403**

Includes topology and number theory.

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Includes physics (general); acoustics; atomic and molecular physics; nuclear and high-energy physics; optics; plasma physics; solid-state physics; and thermodynamics and statistical physics.

For related information see also *Engineering.*

70 PHYSICS (GENERAL) **1404**

For precision time and time interval (PTTI) see *35 Instrumentation and Photography;* for geophysics, astrophysics or solar physics see *46 Geophysics, 90 Astrophysics,* or *92 Solar Physics.*

71 ACOUSTICS 1404
Includes sound generation, transmission, and attenuation.
For noise pollution see *45 Environment Pollution.*

72 ATOMIC AND MOLECULAR PHYSICS 1406
Includes atomic structure, electron properties, and molecular spectra.

73 NUCLEAR AND HIGH-ENERGY PHYSICS 1408
Includes elementary and nuclear particles; and reactor theory.
For space radiation see *93 Space Radiation.*

74 OPTICS 1408
Includes light phenomena and optical devices.
For lasers see *36 Lasers and Masers.*

75 PLASMA PHYSICS 1410
Includes magnetohydrodynamics and plasma fusion.
For ionospheric plasmas see *46 Geophysics.* For space plasmas see *90 Astrophysics.*

76 SOLID-STATE PHYSICS 1415
Includes superconductivity.
For related information see also *33 Electronics and Electrical Engineering* and *36 Lasers and Masers.*

77 THERMODYNAMICS AND STATISTICAL PHYSICS 1422
Includes quantum mechanics; theoretical physics; and Bose and Fermi statistics.
For related information see also *25 Inorganic and Physical Chemistry* and *34 Fluid Mechanics and Heat Transfer.*

SOCIAL SCIENCES

Includes social sciences (general); administration and management; documentation and information science; economics and cost analysis; law, political science, and space policy; and urban technology and transportation.

80 SOCIAL SCIENCES (GENERAL) N.A.
Includes educational matters.

81 ADMINISTRATION AND MANAGEMENT 1423
Includes management planning and research.

82 DOCUMENTATION AND INFORMATION SCIENCE 1424
Includes information management; information storage and retrieval technology; technical writing; graphic arts; and micrography.
For computer documentation see *61 Computer Programming and Software.*

83 ECONOMICS AND COST ANALYSIS 1425
Includes cost effectiveness studies.

84 LAW, POLITICAL SCIENCE AND SPACE POLICY 1426
Includes NASA appropriation hearings; aviation law; space law and policy; international law; international cooperation; and patent policy.

85 URBAN TECHNOLOGY AND TRANSPORTATION 1426
Includes applications of space technology to urban problems; technology transfer; technology assessment; and surface and mass transportation.
For related information see *03 Air Transportation and Safety, 16 Space Transportation,* and *44 Energy Production and Conversion.*

SPACE SCIENCES

Includes space sciences (general); astronomy; astrophysics; lunar and planetary exploration; solar physics; and space radiation.
For related information see also *Geosciences.*

88 SPACE SCIENCES (GENERAL) N.A.

89 ASTRONOMY 1427
Includes radio, gamma-ray, and infrared astronomy; and astrometry.

90 ASTROPHYSICS 1428
Includes cosmology; celestial mechanics; space plasmas; and interstellar and interplanetary gases and dust.
For related information see also *75 Plasma Physics.*

91 LUNAR AND PLANETARY EXPLORATION 1430
Includes planetology; and manned and unmanned flights.
For spacecraft design or space stations see *18 Spacecraft Design, Testing and Performance.*

92 SOLAR PHYSICS 1430
Includes solar activity, solar flares, solar radiation and sunspots.
For related information see *93 Space Radiation.*

93 SPACE RADIATION 1431
Includes cosmic radiation; and inner and outer earth's radiation belts.
For biological effects of radiation see *52 Aerospace Medicine.* For theory see *73 Nuclear and High-Energy Physics.*

GENERAL

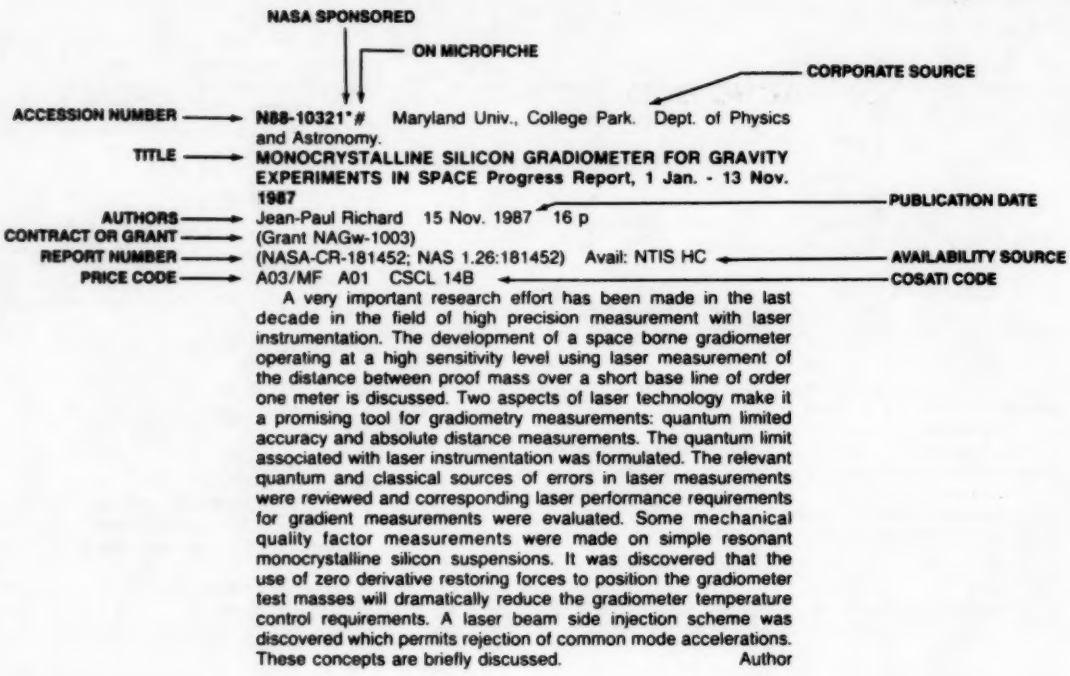
Includes aeronautical, astronautical, and space science related histories, biographies, and pertinent reports too broad for categorization; histories or broad overviews of NASA programs.

99 GENERAL 1431

Note: N.A. means that no abstracts were assigned to this category for this issue.

SUBJECT INDEX I-1
PERSONAL AUTHOR INDEX I-57
CORPORATE SOURCE INDEX I-65
CONTRACT NUMBER INDEX I-79
REPORT/ACCESSION NUMBER INDEX I-83

TYPICAL CITATION AND ABSTRACT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ACCESSION NUMBER
N88-10321*# Maryland Univ., College Park. Dept. of Physics and Astronomy.
TITLE
MONOCRYSTALLINE SILICON GRADIOMETER FOR GRAVITY EXPERIMENTS IN SPACE Progress Report, 1 Jan. - 13 Nov. 1987
PUBLICATION DATE
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(NASA-CR-181452; NAS 1.26:181452) Avail: NTIS HC
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PRICE CODE
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COSATI CODE
A very important research effort has been made in the last decade in the field of high precision measurement with laser instrumentation. The development of a space borne gradiometer operating at a high sensitivity level using laser measurement of the distance between proof mass over a short base line of order one meter is discussed. Two aspects of laser technology make it a promising tool for gradiometry measurements: quantum limited accuracy and absolute distance measurements. The quantum limit associated with laser instrumentation was formulated. The relevant quantum and classical sources of errors in laser measurements were reviewed and corresponding laser performance requirements for gradient measurements were evaluated. Some mechanical quality factor measurements were made on simple resonant monocrystalline silicon suspensions. It was discovered that the use of zero derivative restoring forces to position the gradiometer test masses will dramatically reduce the gradiometer temperature control requirements. A laser beam side injection scheme was discovered which permits rejection of common mode accelerations. These concepts are briefly discussed. Author

VOLUME 26 NUMBER 10/ MAY 23, 1988

Scientific and Technical Aerospace Reports

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01 AERONAUTICS (GENERAL)

N88-17847# Messerschmitt-Boelkow-Blohm G.m.b.H., Hamburg (West Germany). Unternehmensgruppe Transport- und Verkehrsflugzeuge.
AIRBUS, THE SUCCESSFUL EUROPEAN COOPERATION [AIRBUS - DIE ERFOLGREICHE EUROPAEISCHE KOOPERATION]
Hartmut Mehdorn *In its* Research and Development. Technical-Scientific Publications (1956-1987): Retrospective View and Prospects. Jubilee Edition on the Occasion of the 75th Anniversary of Dipl.-Engr. Dr.-Engr. E.H. Ludwig Boelkow 1987 p 179-182 In GERMAN (For primary document see N88-17819 10-31)
(MBB-UT-005/87) Copyright Avail: NTIS HC A14/MF A01

N88-17849# Messerschmitt-Boelkow-Blohm G.m.b.H., Hamburg (West Germany). Unternehmensgruppe Transport- und Verkehrsflugzeuge.
PRODUCT PLANNING IN CIVIL AIRCRAFT CONSTRUCTION [PRODUKTPLANUNG IM ZIVILEN FLUGZEUGBAU]
Werner Zabka *In its* Research and Development. Technical-Scientific Publications (1956-1987): Retrospective View and Prospects. Jubilee Edition on the Occasion of the 75th Anniversary of Dipl.-Engr. Dr.-Engr. E.H. Ludwig Boelkow 1987 p 187-196 In GERMAN (For primary document see N88-17819 10-31)
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02 AERODYNAMICS

Includes aerodynamics of bodies, combinations, wings, rotors, and control surfaces; and internal flow in ducts and turbomachinery.

For related information see also *34 Fluid Mechanics and Heat Transfer.*

N88-17578 Cornell Univ., Ithaca, N.Y.
A DYNAMICAL SYSTEM/COHERENT STRUCTURE APPROACH TO THE FULLY DEVELOPED TURBULENT WALL LAYER Ph.D. Thesis
Nadine Aubry 1987 164 p
Avail: Univ. Microfilms Order No. DA8724131

Until recently, dynamical system approaches to turbulence were restricted to transition problems and essentially limited to closed flow systems. However, these ideas are applied to a fully developed turbulent open flow system, the wall region of a turbulent boundary layer. Relevant modes in the inhomogeneous direction are determined by use of a coherent structure approach, the proper orthogonal decomposition proposed by Lumley. The decomposition provides a set of eigenfunctions which are experimentally determined from second order statistical data. By Galerkin projection, sets of ordinary differential equations are obtained for the time dependent coefficients of the expansion. The energy transfer to unresolved models is modelled by a representation similar to Heisenberg's spectral model. The expansion, truncated with one eigenmode and five active cross stream Fourier modes leads to a ten dimensional dynamical system which exhibits different behaviors as the Heisenberg parameter decreases. First the solution is steady and represents a quiescent structure of low speed longitudinal streaks gradually moving away from the wall. Next, the rolls reform and the process is repeated.
Dissert. Abstr.

N88-17579 Princeton Univ., N. J.
SOLUTION OF THE THREE-DIMENSIONAL NAVIER-STOKES EQUATIONS FOR TRANSONIC FLOW USING A MULTIGRID METHOD Ph.D. Thesis
Mohan Jayaram 1987 132 p
Avail: Univ. Microfilms Order No. DA8722569

Solutions are obtained for steady, transonic flow over airplane wings by solving the three dimensional Reynolds averaged Navier-Stokes equations. Both laminar and turbulent flows, both attached and separated, are addressed. Emphasis is placed on efficiency and accuracy. The three dimensional Navier-Stokes equations are discretized by a finite volume technique. This offers flexibility in treating arbitrary geometries. A central differencing procedure is used to approximate spatial derivatives thereby ensuring second order accuracy. The resulting set of ordinary differential equations is integrated in time to reach a steady state using an explicit hybrid multistage scheme. Author

N88-17580 Stanford Univ., Calif.
CONTROL OF VORTICAL SEPARATION ON CONICAL BODIES Ph.D. Thesis
Nikos John Mourtos 1987 200 p
Avail: Univ. Microfilms Order No. DA8723056

In a variety of aeronautical applications, the flow around conical bodies at incidence is of interest. For such conical bodies, starting at moderate angles of attack, the flow separates from the lee side, forming two vortices. Although the vortex lift contribution is highly desirable, as the angle of attack increases, the vortex system becomes asymmetric, and eventually the vortices breakdown. This causes problems with stability in all directions. Thus, some control of the separation process is necessary if the vortex lift is to be exploited at higher angles of attack. The theoretical model which is used in this analysis has three parts. First, the single line vortex model is used within the framework of slender body theory to compute the outer inviscid field for specified separation lines. Next, the three-dimensional boundary layer is represented by a momentum equation for the cross flow, analogous to that for a plane boundary layer. Thirdly, control of separation is achieved by blowing tangentially from a slot located along a cone generator. For very small blowing coefficients, the separation can be postponed or suppressed completely. Dissert. Abstr.

N88-17581*# National Aeronautics and Space Administration. Ames Research Center, Moffett Field, Calif.
APPLICATION OF EMPIRICAL AND LINEAR METHODS TO VSTOL POWERED-LIFT AERODYNAMICS
Richard Margason and Richard Kuhn (Kuhn, Richard E., Valencia, Calif) Feb. 1988 34 p
(NASA-TM-100048; A-88038; NAS 1.15:100048) Avail: NTIS HC A03/MF A01 CSCL 01A

Available prediction methods applied to problems of aero/propulsion interactions for short takeoff and vertical landing

(STOVL) aircraft are critically reviewed and an assessment of their strengths and weaknesses provided. The first two problems deal with aerodynamic performance effects during hover: (1) out-of-ground effect, and (2) in-ground effect. The first can be evaluated for some multijet cases; however, the second problem is very difficult to evaluate for multijets. The ground-environment effects due to wall jets and fountain flows directly affect hover performance. In a related problem: (3) hot-gas ingestion affects the engine operation. Both of these problems as well as jet noise affect the ability of people to work near the aircraft and the ability of the aircraft to operate near the ground. Additional problems are: (4) the power-augmented lift due to jet-flap effects (both in- and out-of-ground effects), and (5) the direct jet-lift effects during short takeoff and landing (STOL) operations. The final problem: (6) is the aerodynamic/propulsion interactions in transition between hover and wing-borne flight. Areas where modern CFD methods can provide improvements to current computational capabilities are identified. Author

N88-17582*# Toledo Univ., Ohio. Coll. of Engineering.
NUMERICAL SIMULATION OF AXISYMMETRIC TURBULENT FLOW IN COMBUSTORS AND DIFFUSORS Ph.D. Thesis. Final Report
Chain Nan Yung Feb. 1988 177 p
(Grant NAG3-355)
(NASA-CR-4115; E-3853; NAS 1.26:4115) Avail: NTIS HC A09/MF A01 CSCL 01A

A method for predicting turbulent flow in combustors and diffusers is developed. The Navier-Stokes equations, incorporating a turbulence kappa-epsilon model equation, were solved in a nonorthogonal curvilinear coordinate system. The solution applied the finite volume method to discretize the differential equations and utilized the SIMPLE algorithm iteratively to solve the differenced equations. A zonal grid method, wherein the flow field was divided into several subsections, was developed. This approach permitted different computational schemes to be used in the various zones. In addition, grid generation was made a more simple task. However, treatment of the zonal boundaries required special handling. Boundary overlap and interpolating techniques were used and an adjustment of the flow variables was required to assure conservation of mass, momentum and energy fluxes. The numerical accuracy was assessed using different finite differencing methods, i.e., hybrid, quadratic upwind and skew upwind, to represent the convection terms. Flows in different geometries of combustors and diffusers were simulated and results compared with experimental data and good agreement was obtained. Author

N88-17583*# Imperial Coll. of Science and Technology, London (England). Dept. of Aeronautics.
BURST VORTEX/BOUNDARY LAYER INTERACTION Progress Report, 1 Sep. 1987 - 29 Feb. 1988
P. Bradshaw and M. Naaseri 14 Mar. 1988 27 p
(Grant NAGw-581)
(NASA-CR-182510; NAS 1.26:182510) Avail: NTIS HC A03/MF A01 CSCL 01A

Several configurations of delta wing vortex generator and boundary layer test plate were tested, and two final ones selected. Sample measurements and flow visualizations in the candidate configurations, together with more detailed measurements in one of the two final arrangements, which were selected so that a pure vortex bursts repeatably and then interacts, in as simple fashion as possible, with a simple turbulent boundary layer, are included. It is concluded that different intensities of bursting or breakdown, like different strengths of shock wave or hydraulic jump, can be produced by minor changes of configuration. The weaker breakdowns do not produce flow reversal. The initial measurements were done with a fairly weak, but repeatable, breakdown. Basic measurements on the second final arrangement, with a stronger breakdown, are in progress. Author

N88-17584*# National Aeronautics and Space Administration. Ames Research Center, Moffett Field, Calif.
NAVIER-STOKES SIMULATION OF WIND-TUNNEL FLOW USING LU-ADI FACTORIZATION ALGORITHM
Shigeru Obayashi, Kozo Fujii, and Sharad Gavali (Amdahl Corp., Sunnyvale, Calif.) Feb. 1988 29 p
(NASA-TM-100042; A-88027; NAS 1.15:100042) Avail: NTIS HC A03/MF A01 CSCL 01A

The three dimensional Navier-Stokes solution code using the LU-ADI factorization algorithm was employed to simulate the workshop test cases of transonic flow past a wing model in a wind tunnel and in free air. The effect of the tunnel walls is well demonstrated by the present simulations. An Amdahl 1200 supercomputer having 128 Mbytes main memory was used for these computations. Author

N88-17585*# Kuhn (Richard E.), Newport News, Va.
RECOMMENDATIONS FOR GROUND EFFECTS RESEARCH FOR V/STOL AND STOL AIRCRAFT AND ASSOCIATED EQUIPMENT FOR LARGE SCALE TESTING
Richard E. Kuhn Mar. 1986 110 p
(Contract NAS2-11912)
(NASA-CR-177429; NAS 1.26:177429) Avail: NTIS HC A06/MF A01 CSCL 01A

The current understanding of the effects of ground proximity on V/STOL and STOL aircraft is reviewd. Areas covered include (1) single jet suckdown in hover, (2) fountain effects on multijet configurations, (3) STOL ground effects including the effect of the ground vortex flow field, (4) downwash at the tail, and (5) hot gas ingestion in both hover and STOL operation. The equipment needed for large scale testing to extend the state of the art is reviewed and developments in three areas are recommended as follows: (1) improve methods for simulating the engine exhaust and inlet flows; (2) develop a model support system that can simulate realistic rates of climb and descent as well as steady height operation; and (3) develop a blowing BLC ground board as an alternative to a moving belt ground board to properly simulate the flow on the ground. Author

N88-17586*# National Aeronautics and Space Administration. Ames Research Center, Moffett Field, Calif.
PROCEEDINGS OF THE CIRCULATION-CONTROL WORKSHOP, 1986
Jack N. Nielsen, comp. May 1987 591 p Workshop held at Moffett Field, Calif., 19-21 Feb. 1986 Original contains color illustrations
(NASA-CP-2432; A-86314; NAS 1.55:2432) Avail: NTIS HC A25/MF A01 CSCL 01A

A Circulation Control Workshop was held at NASA Ames by respresentatives of academia, industry, and government. A total of 32 papers were given in six technical sessions covering turbulence, circulation control airfoil theory, circulation control airfoil wing experiments, circulation control rotor theory, x-wing technology, fixed wing technology, and other concepts. The last session of the workshop was devoted to circulation control research planning. For individual titles, see N88-17587 through N88-17610.

N88-17587*# National Aeronautics and Space Administration. Ames Research Center, Moffett Field, Calif.
NAVIER-STOKES CALCULATIONS AND TURBULENCE MODELING IN THE TRAILING EDGE REGION OF A CIRCULATION CONTROL AIRFOIL
John R. Viegas, Morris W. Rubesin, and Robert W. MacCormack (Stanford Univ., Calif.) *In its* Proceedings of the Circulation-Control Workshop, 1986 May 1987 p 1-22 (For primary document see N88-17586 10-02)
(Contract NCA2-40)
Avail: NTIS HC A25/MF A01 CSCL 01A

The accurate prediction of turbulent flows over curved surfaces in general and over the trailing edge region of circulation control airfoils in particular requires the coupled efforts of turbulence modelers, numerical analysts and experimentalists. The purpose

of the research program in this area is described. Then, the influence on turbulence modeling of the flow characteristics over a typical circulation control wing is discussed. Next, the scope of this effort to study turbulence in the trailing edge region of a circulation control airfoil is presented. This is followed by a brief overview of the computation scheme, including the grid, governing equations, numerical method, boundary conditions and turbulence models applied to date. Then, examples of applications of two algebraic eddy viscosity models to the trailing edge region of a circulation control airfoil is presented. The results from the calculations is summarized, and conclusions drawn based on examples. Finally, the future directions of the program is outlined. Author

N88-17588*# Science Applications International Corp., Princeton, N.J.

WALL JET ANALYSIS FOR CIRCULATION CONTROL AERODYNAMICS. PART 1: FUNDAMENTAL CFD AND TURBULENCE MODELING CONCEPTS

S. M. Dash, B. J. York, N. Sinha, and F. A. Dvorak (Analytical Methods, Inc., Redmond, Wash.) *In* NASA. Ames Research Center Proceedings of the Circulation-Control Workshop, 1986 May 1987 p 23-69 Sponsored in part by David Taylor Research and Development Center (For primary document see N88-17586 10-02)

Avail: NTIS HC A25/MF A01 CSCL 01A

An overview of parabolic and PNS (Parabolized Navier-Stokes) methodology developed to treat highly curved sub and supersonic wall jets is presented. The fundamental data base to which these models were applied is discussed in detail. The analysis of strong curvature effects was found to require a semi-elliptic extension of the parabolic modeling to account for turbulent contributions to the normal pressure variations, as well as an extension to the turbulence models utilized, to account for the highly enhanced mixing rates observed in situations with large convex curvature. A noniterative, pressure split procedure is shown to extend parabolic models to account for such normal pressure variations in an efficient manner, requiring minimal additional run time over a standard parabolic approach. A new PNS methodology is presented to solve this problem which extends parabolic methodology via the addition of a characteristic base wave solver. Applications of this approach to analyze the interaction of wave and turbulence processes in wall jets is presented. Author

N88-17589*# Lockheed-Georgia Co., Marietta.

INVESTIGATIONS OF A CIRCULATION CONTROL AIRFOIL FLOWFIELD USING AN ADVANCED LASER VELOCIMETER

Charles J. Novak and Kenneth C. Cornelius *In* NASA. Ames Research Center Proceedings of the Circulation-Control Workshop, 1986 May 1987 p 71-98 (For primary document see N88-17586 10-02)

Avail: NTIS HC A25/MF A01 CSCL 01A

The flowfield of a Circulation Control Airfoil was examined in detail through the use of a specially designed wind tunnel model and test program. Surface pressures on the model were obtained and the velocity field was surveyed in the trailing edge region of the model airfoil using the nonintrusive Laser Velocimetry technique. In this region mean flow and turbulence measurements indicate that, while the flowfield is similar to other wall-bounded jet flows, the external freestream plays an important role in the overall mixing and structure of the wall bounded flow. Finally, the turbulence measurements were used to compute eddy viscosities for the purpose of aiding computational fluid dynamics model development. Author

N88-17590*# Stanford Univ., Calif. Joint Inst. for Aeronautics and Acoustics.

A THEORY FOR TURBULENT CURVED WALL JETS

Leonard Roberts *In* NASA. Ames Research Center Proceedings of the Circulation-Control Workshop, 1986 May 1987 p 99-112 (For primary document see N88-17586 10-02)

Avail: NTIS HC A25/MF A01 CSCL 01A

An attempt is made to formulate the simplest possible model for the flow of a wall jet emanating from a two dimensional source into quiescent surroundings in the presence of a wall of arbitrary shape. The method used self similar profiles for the mean velocity together with a simple eddy viscosity model. The streamwise and radial momentum equations are integrated across the wall jet flow to give an expression for the momentum balance including the effect of the pressure gradient induced by the rate of change of surface curvature. The streamwise momentum equation is also evaluated at the point of maximum velocity to provide a second equation and thereby permit a solution for the two unknown quantities, the jet half width and the maximum velocity. This approach provides approximate closed form solutions for the flow of the wall jet over surfaces of various shapes, and in particular permits a direct comparison with the available experimental results for plane, cylindrical or logarithmic spiral surfaces. Author

N88-17591*# Lockheed-Georgia Co., Marietta. Advanced Flight Sciences Dept.

EVALUATION OF A RESEARCH CIRCULATION CONTROL AIRFOIL USING NAVIER-STOKES METHODS

George D. Shrewsbury *In* NASA. Ames Research Center Proceedings of the Circulation-Control Workshop, 1986 May 1987 p 115-134 Previously announced in IAA as A87-22754 (For primary document see N88-17586 10-02)

Avail: NTIS HC A25/MF A01 CSCL 01A

The compressible Reynolds time averaged Navier-Stokes equations were used to obtain solutions for flows about a two dimensional circulation control airfoil. The governing equations were written in conservation form for a body-fitted coordinate system and solved using an Alternating Direction Implicit (ADI) procedure. A modified algebraic eddy viscosity model was used to define the turbulent characteristics of the flow, including the wall jet flow over the Coanda surface at the trailing edge. Numerical results are compared to experimental data obtained for a research circulation control airfoil geometry. Excellent agreement with the experimental results was obtained. Author

N88-17592*# National Aeronautics and Space Administration. Ames Research Center, Moffett Field, Calif.

NAVIER-STOKES COMPUTATIONS FOR CIRCULATION CONTROL AIRFOILS

Thomas H. Pulliam, Dennis C. Jespersen, and Timothy J. Barth *In its* Proceedings of the Circulation-Control Workshop, 1986 May 1987 p 135-163 Previously announced as N86-30995 (For primary document see N88-17586 10-02)

Avail: NTIS HC A25/MF A01 CSCL 01A

Navier-Stokes computations of subsonic to transonic flow past airfoils with augmented lift due to rearward jet blowing over a curved trailing edge are presented. The approach uses a spiral grid topology. Solutions are obtained using a Navier-Stokes code which employs an implicit finite difference method, an algebraic turbulence model, and developments which improve stability, convergence, and accuracy. Results are compared against experiments for no jet blowing and moderate jet pressures and demonstrate the capability to compute these complicated flows. Author

N88-17593*# Analytical Methods, Inc., Redmond, Wash.

WALL JET ANALYSIS FOR CIRCULATION CONTROL AERODYNAMICS. PART 2: ZONAL MODELING CONCEPTS FOR WALL JET/POTENTIAL FLOW COUPLING

Frank A. Dvorak and Sanford M. Dash (Science Applications International Corp., Princeton, N.J.) *In* NASA. Ames Research Center Proceedings of the Circulation-Control Workshop, 1986 May 1987 p 165-181 (For primary document see N88-17586 10-02)

Avail: NTIS HC A25/MF A01 CSCL 01A

Work currently in progress to update an existing transonic circulation control airfoil analysis method is described. Existing methods suffer from two dificiencies: the inability to predict the shock structure of the underexpanded supersonic jets; and the insensitivity of the calculation to small changes in the Coanda

surface geometry. A method developed for the analysis of jet exhaust plumes in supersonic flow is being modified for the case of the underexpanded wall jet. In the subsonic case, the same wall jet model was modified to include the calculation of the normal pressure gradient. This model is currently being coupled with the transonic circulation control airfoil analysis. Author

N88-17594*# Stanford Univ., Calif.
THE FURTHER DEVELOPMENT OF CIRCULATION CONTROL AIRFOILS
N. J. Wood *In* NASA. Ames Research Center Proceedings of the Circulation-Control Workshop, 1986 May 1987 p 183-196 (For primary document see N88-17586 10-02)
Avail: NTIS HC A25/MF A01 CSCL 01A

The performance trends of circulation control airfoils are reviewed and observations are made as to where improvements in performance and expansion of the flight envelope may be feasible. A new analytically defined family of airfoils is suggested, all of which maintain the fore and aft symmetry required for stopped rotor application. It is important to recognize that any improvements in section capabilities may not be totally applicable to the present vehicle operation. It remains for the designers of the rotor system to reappraise the three dimensional operating environment in view of the different airfoil operating characteristics and for the airfoil definitions to be flexible while maintaining satisfactory levels of performance. Author

N88-17595*# National Aeronautics and Space Administration. Ames Research Center, Moffett Field, Calif.
ON THE EFFECT OF LEADING EDGE BLOWING ON CIRCULATION CONTROL AIRFOIL AERODYNAMICS
B. G. McLachlan *In its* Proceedings of the Circulation-Control Workshop, 1986 May 1987 p 199-208 (For primary document see N88-17586 10-02)
Avail: NTIS HC A25/MF A01 CSCL 01A

In the present context the term circulation control is used to denote a method of lift generation that utilizes tangential jet blowing over the upper surface of a rounded trailing edge airfoil to determine the location of the boundary layer separation points, thus setting an effective Kutta condition. At present little information exists on the flow structure generated by circulation control airfoils under leading edge blowing. Consequently, no theoretical methods exist to predict airfoil performance under such conditions. An experimental study of the flow field generated by a two dimensional circulation control airfoil under steady leading and trailing edge blowing was undertaken. The objective was to fundamentally understand the overall flow structure generated and its relation to airfoil performance. Flow visualization was performed to define the overall flow field structure. Measurements of the airfoil forces were also made to provide a correlation of the observed flow field structure to airfoil performance. Preliminary results are presented, specifically on the effect on the flow field structure of leading edge blowing, alone and in conjunction with trailing edge blowing. Author

N88-17596*# National Aeronautics and Space Administration. Ames Research Center, Moffett Field, Calif.
PRESSURE DISTRIBUTIONS AND OIL-FLOW PATTERNS FOR A SWEPT CIRCULATION-CONTROL WING
Earl R. Keener, Dwight T. Sanderfer, and Norman J. Wood (Stanford Univ., Calif.) *In its* Proceedings of the Circulation-Control Workshop, 1986 May 1987 p 209-238 (For primary document see N88-17586 10-02)
Avail: NTIS HC A25/MF A01 CSCL 01A

Pressure distributions and photographs of oil flow patterns are presented for a circulation control wing. The model was an aspect ratio four semispan wing mounted on the side wall of the NASA Ames Transonic Wind Tunnel. The airfoil was a 20 percent thick ellipse, modified with circular leading and trailing edges of 4 percent radius, and had a 25.4 cm constant chord. This configuration does not represent a specific wing design, but is generic. A full span, tangetial, rearward blowing, circulation control slot was incorporated ahead of the trailing edge on the upper surface. The wing was tested at Mach numbers from 0.3 to 0.75 at sweep angle of 0 to 45 deg with internal to external pressure ratios of 1.0 to 3.0. Lift and pitching momemt coefficients were obtained from measured pressure distributions at five span stations. When the conventional corrections resulting from sweep angle are applied to the lift and moment of circulation control sections, no additional corrections are necessary to account for changes in blowing efficiency. This is demonstrated for an aft sweep angle of 45 deg. An empirical technique for estimating the downwash distribution of a swept wing was validated. Author

N88-17597*# National Aeronautics and Space Administration. Ames Research Center, Moffett Field, Calif.
BOUNDARY-LAYER AND WAKE MEASUREMENTS ON A SWEPT, CIRCULATION-CONTROL WING
Frank W. Spaid (McDonnell-Douglas Research Labs., St. Louis, Mo.) and Earl R. Keener *In its* Proceedings of the Circulation-Control Workshop, 1986 May 1987 p 239-266 Previously announced in IAA as A87-22449 (For primary document see N88-17586 10-02)
Avail: NTIS HC A25/MF A01 CSCL 01A

Wind tunnel measurements of boundary layer and wake velocity profiles and surface static pressure distributions are presented for a swept, circulation control wing. The model is an aspect ratio four semispan wing mounted on the tunnel side wall as a sweep angle of 45 deg. A full span, tangetial, rearward blowing, circulation control slot is located ahead of the trailing edge on the upper surface. Flow surveys were obtained at mid-semispan at freestream Mach numbers of 0.425 and 0.70. Boundary layer profiles measured on the forward portions of the wing are approximately streamwise and two dimensional. The flow in the vicinity of the jet exit and in the near wake is highly three dimensional. The jet flow near the slot on the Coanda surface is directed normal to the slot. Near wake surveys show large outboard flows at the center of the wake. At Mach 0.425 and a 5 deg angle of attack, a range of jet blowing rates was found for which an abrupt transition from incipient separation to attached flow occurs in the boundary layer upstream of the slot. The variation in the lower surface separation location with blowing rate was determined from the boundary layer measurements at Mach 0.425. Author

N88-17598*# Air Force Inst. of Tech., Wright-Patterson AFB, Ohio.
WIND TUNNEL STUDIES OF CIRCULATION CONTROL ELLIPTICAL AIRFOILS
M. E. Franke and J. K. Harvell *In* NASA. Ames Research Center Proceedings of the Circulation-Control Workshop, 1986 May 1987 p 267-287 (For primary document see N88-17586 10-02)
Avail: NTIS HC A25/MF A01 CSCL 01A

Effects of blown jets on the lift and drag of cambered elliptical airfoils are described. Performance changes due to a splitter plate attached to the lower surface of an elliptical airfoil near the trailing edge with and without blowing are indicated. Lift and drag characteristics of airfoils with two blown jets are compared with airfoils with single blowing jets. Airfoil designs that vary the location of a second jet relative to a fixed jet are described. Author

N88-17599*# Lockheed-Advanced Aeronautics Co., Valencia, Calif.
DESIGN OF SUPERSONIC COANDA JET NOZZLES
Paul M. Bevilaqua and John D. Lee (Ohio State Univ., Columbus.) *In* NASA. Ames Research Center Proceedings of the Circulation-Control Workshop, 1986 May 1987 p 289-312 Previously announced in IAA as A84-18026 (For primary document see N88-17586 10-02)
Avail: NTIS HC A25/MF A01 CSCL 01A

The thrust vectoring of supersonic Coanda jets was improved by designing a nozzle to skew the initial jet velocity profile. A new nozzle design procedure, based on the method of characteristics, was developed to design a nozzle which produces a specified exit velocity profile. The thrust vectoring of a simple convergent nozzle, a convergent-divergent nozzle, and a nozzle which produces

a skewed velocity profile matched to the curvature of the Coanda surface were expermentially compared over a range of pressure ratios from 1.5 to 3.5. Elimination of the expansion shocks with the C-D nozzle is shown to greatly improve the thrust vectoring; elimination of turning shocks with the skewed profile nozzle further improves the vectoring. Author

N88-17600*# Maryland Univ., College Park.
FLAP-LAG-TORSION AEROELASTIC STABILITY OF A CIRCULATION CONTROL ROTOR IN FORWARD FLIGHT
Inderjit Chopra and Chang-Ho Hong *In* NASA. Ames Research Center Proceedings of the Circulation-Control Workshop, 1986 May 1987 p 315-352 Sponsored in part by David Taylor Naval Ship Research and Develop Center (For primary document see N88-17586 10-02)
(Contract N0016785-M-4464)
Avail: NTIS HC A25/MF A01 CSCL 01A

The aeroelastic stability of a circulation control rotor blade undergoing three degrees of motion (flap, lag, and torsion) is investigated in forward flight. Quasi-steady strip theory is used to evaluate the aerodynamics forces; and the airfoil characteristics are from data tables. The propulsive and the auxiliary power trims are calculated from vehicle and rotor equilibrium equations through the numerical integration of element forces in azimuth as well as in radial directions. The nonlinear time dependent periodic blade response is calculated using an iterative procedure based on Floquet theory. The periodic perturbation equations are solved for stability using Floquet transition matrix theory. The effects of several parameters on blade stability are examined, including advance ratio, collective pitch, thrust level, shaft tilt, structural stiffnesses variation, and propulsive and auxiliary power trims. Author

N88-17601*# Sikorsky Aircraft, Stratford, Conn.
THE IMPACT OF CIRCULATION CONTROL ON ROTARY AIRCRAFT CONTROLS SYSTEMS **c08**
R. F. Kingloff and D. E. Cooper *In* NASA. Ames Research Center Proceedings of the Circulation-Control Workshop, 1986 May 1987 p 353-362 (For primary document see N88-17586 10-02)
Avail: NTIS HC A25/MF A01 CSCL 01C

Application of circulation to rotary wing systems is a new development. Efforts to determine the near and far field flow patterns and to analytically predict those flow patterns have been underway for some years. Rotary wing applications present a new set of challenges in circulation control technology. Rotary wing sections must accomodate substantial Mach number, free stream dynamic pressure and section angle of attack variation at each flight condition within the design envelope. They must also be capable of short term circulation blowing modulation to produce control moments and vibration alleviation in addition to a lift augmentation function. Control system design must provide this primary control moment, vibration alleviation and lift augmentation function. To accomplish this, one must simultaneously control the compressed air source and its distribution. The control law algorithm must therefore address the compressor as the air source, the plenum as the air pressure storage and the pneumatic flow gates or valves that distribute and meter the stored pressure to the rotating blades. Also, mechanical collective blade pitch, rotor shaft angle of attack and engine power control must be maintained.
Author

N88-17602*# Naval Ship Research and Development Center, Bethesda, Md.
ANALYSIS OF A FIXED-PITCH X-WING ROTOR EMPLOYING LOWER SURFACE BLOWING
Alan W. Schwartz and Ernest O. Rogers *In* NASA. Ames Research Center Proceedings of the Circulation-Control Workshop, 1986 May 1987 p 363-380 (For primary document see N88-17586 10-02)
Avail: NTIS HC A25/MF A01 CSCL 01A

Lower surface blowing (LSB) is investigated as an alternative to the variable blade pitch requirement for the X-wing Circulation Control (CC) rotor concept. Addition trailing edge blowing slots on the lower surfaces of CC airfoils provide a bidirectional lift capability that effectively doubles the control range. The operational requirements of this rotor system are detailed and compared to the projected performance attributes of LSB airfoils. Analysis shows that, aerodynamically, LSB supplies a fixed pitch rotor system with the equivalent lift efficiency and rotor control of present CC rotor designs that employ variable blade pitch. Aerodynamic demands of bidirectional lift production are predicted to be within the capabilities of current CC airfoil design methodology. Emphasis in this analysis is given to the high speed rotary wing flight regime unique to stoppable rotor aircraft. The impact of a fixed pitch restriction in hover and low speed flight is briefly discussed.
Author

N88-17603*# Sikorsky Aircraft, Stratford, Conn.
PREDICTION OF AEROELASTIC RESPONSE OF A MODEL X-WING ROTOR
Robert Dopher and James E. Duh *In* NASA. Ames Research Center Proceedings of the Circulation-Control Workshop, 1986 May 1987 p 383-398 Previously announced in IAA as A88-20000 (For primary document see N88-17586 10-02)
Avail: NTIS HC A25/MF A01 CSCL 01A

The rotorcraft dynamics analysis was used to predict the aeroelastic responses of a representative X-wing model with a 10 ft diameter rotor. The aeroelastic methodology used and the tests and assumptions involved are reviewed. Results are reported on the findings concerning control power and higher harmonic control in hover, transition flight, vibratory loads at forward speed, and responses in conversion. It is concluded that the analysis can give satisfactory predictions of X-wing behavior. E.R.

N88-17604*# Sikorsky Aircraft, Stratford, Conn.
X-WING POTENTIAL FOR NAVY APPLICATIONS
Arthur W. Linden and James C. Biggers (Naval Ship Research and Development Center, Bethesda, Md.) *In* NASA. Ames Research Center Proceedings of the Circulation-Control Workshop, 1986 May 1987 p 399-425 (For primary document see N88-17586 10-02)
Avail: NTIS HC A25/MF A01 CSCL 01A

The X-wing provides a VTOL aircraft which has a low disc loading hover capability, similar to a conventional helicopter, combined with a high subsonic cruise speed capability. As a result, it hovers with low fuel flow rates which make extended hover duration missions practical. Its low hover power requirements also permit hovering and low speed flight on only one engine in a high speed twin engine aircraft design. The NASA DARPA Sikorsky RSRA X-wing program developed flightworthy X-wing hardware. All design activity and the majority of its component fabrication is completed. A design study was performed on an X-wing concept demonstrator aircraft which is based on the RSRA X-wing components, combined with two MTE engines and a new fuselage. Author

N88-17605*# National Aeronautics and Space Administration. Ames Research Center, Moffett Field, Calif.
REDUCTION OF TILT ROTOR DOWNLOAD USING CIRCULATION CONTROL
Fort F. Felker, Jeffrey S. Light, and Robert E. Faye (California Polytechnic State Univ., San Luis Obispo.) *In its* Proceedings of the Circulation-Control Workshop, 1986 May 1987 p 429-447 (For primary document see N88-17586 10-02)
Avail: NTIS HC A25/MF A01 CSCL 01A

The effect of boundary layer control blowing on the download of a wing in the wake of a hovering rotor was measured in a small scale experiment. The objective was to evaluate the potential of boundary layer control blowing for reducing tilt rotor download. Variations were made in rotor thrust coefficient, blowing pressure ratio, and blowing slot height. The effect of these parameter variations on the wing download and wing surface pressures is presented. The boundary layer control blowing caused reductions in the wing download of 25 to 55 percent. Author

N88-17606*# Grumman Aerospace Corp., Bethpage, N.Y.
AN AERODYNAMIC COMPARISON OF BLOWN AND MECHANICAL HIGH LIFT AIRFOILS
John E. Carr *In* NASA. Ames Research Center Proceedings of the Circulation-Control Workshop, 1986 May 1987 p 449-477 (For primary document see N88-17586 10-02)
Avail: NTIS HC A25/MF A01 CSCL 01A

Short takeoff and landing (STOL) performance utilizing a circulation control airfoil was successfully demonstrated on the A-6 CCW (circulation control wing). Controlled flight at speeds as slow as 67 knots was demonstrated. Takeoff ground run and liftoff speed reductions in excess of 40 and 20 percent respectively were achieved. Landing ground roll and approach speeds were similarly reduced. The technology demonstrated was intended to be useable on modern high performance aircraft. STOL performance would be achieved through the combination of a 2-D vectored nozzle and a circulation control type of high lift system. The primary objective of this demonstration was to attain A-6 CCW magnitude reductions in takeoff and landing flight speed and ground distance requirements using practical bleed flow rates from a modern turbofan engine for the blown flap system. Also, cruise performance could not be reduced by the wing high lift system. The A-6 was again selected as the optimum demonstration vehicle. The procedure and findings of the study to select the optimum high lift wing design are documented. Some findings of a supercritical airfoil and a comparison of 2-D and 3-D results are also described. Author

N88-17607*# Naval Ship Research and Development Center, Bethesda, Md.
FIXED WING CCW AERODYNAMICS WITH AND WITHOUT SUPPLEMENTARY THRUST DEFLECTION
J. H. Nichols and M. J. Harris *In* NASA. Ames Research Center Proceedings of the Circulation-Control Workshop, 1986 May 1987 p 479-489 (For primary document see N88-17586 10-02)
Avail: NTIS HC A25/MF A01 CSCL 01A

The concept of circulation control was successfully demonstrated in flight using an A-6 aircraft. Circulation control can provide an aircraft with STOL performance of heavy lift capability. For ship based Naval aircraft the lower takeoff and landing velocities result in reduced deck gear and wind over the deck requirements. Circulation control airfoils can be mechanically less complex and lightweight compared to multi-element high lift airfoils. Author

N88-17608*# Lockheed-Georgia Co., Marietta. Advanced Flight Sciences Dept.
DEVELOPMENT OF CIRCULATION CONTROL TECHNOLOGY FOR POWERED-LIFT STOL AIRCRAFT **c05**
Robert J. Englar *In* NASA. Ames Research Center Proceedings of the Circulation-Control Workshop, 1986 May 1987 p 491-537 (For primary document see N88-17586 10-02)
Avail: NTIS HC A25/MF A01 CSCL 01C

The flow entraining capabilities of the Circulation Control Wing high lift system were employed to provide an even stronger STOL potential when synergistically combined with upper surface mounted engines. The resulting configurations generate very high supercirculation lift in addition to a vertical component of the pneumatically deflected engine thrust. A series of small scale wind tunnel tests and full scale static thrust deflection tests are discussed which provide a sufficient data base performance. These tests results show thrust deflections of greater than 90 deg produced pneumatically by nonmoving aerodynamic surfaces, and the ability to maintain constant high lift while varying the propulsive force from high thrust recovery required for short takeoff to high drag generation required for short low speed landings. Author

N88-17609*# National Aeronautics and Space Administration. Ames Research Center, Moffett Field, Calif.
A POTENTIAL FLIGHT EVALUATION OF AN UPPER-SURFACE-BLOWING/CIRCULATION-CONTROL-WING CONCEPT **c05**
Dennis W. Riddle and Joseph C. Eppel *In its* Proceedings of the Circulation-Control Workshop, 1986 May 1987 p 539-567 (For primary document see N88-17586 10-02)
Avail: NTIS HC A25/MF A01 CSCL 01C

The technology data base for powered lift aircraft design has advanced over the last 15 years. NASA's Quiet Short Haul Research Aircraft (QSRA) has provided a flight verification of upper surface blowing (USB) technology. The A-6 Circulation Control Wing flight demonstration aricraft has provide data for circulation control wing (CCW) technology. Recent small scale wind tunnel model tests and full scale static flow turning test have shown the potential of combining USB with CCW technology. A flight research program is deemed necessary to fully explore the performance and control aspects of CCW jet substitution for the mechanical USB Coanda flap. The required hardware design would also address questions about the development of flight weight ducts and CCW jets and the engine bleed-air capabilities vs requirements. NASA's QSRA would be an optimum flight research vehicle for modification to the USB/CCW configuration. The existing QSRA data base, the design simplicity of the QSRA wing trailing edge controls, availability of engine bleed-air, and the low risk, low cost potential of the suggested program is discussed. Author

N88-17610*# West Virginia Univ., Morgantown. Dept. of Mechanical and Aerospace Engineering.
CIRCULATION CONTROL STOL AIRCRAFT DESIGN ASPECTS
John L. Loth *In* NASA. Ames Research Center, Proceedings of the Circulation-Control Workshop, 1986 May 1987 p 569-588 (For primary document see N88-17586 10-02)
(Contract MDA-53-108444630)
Avail: NTIS HC A25/MF A01 CSCL 01A

Since Davidson patented Circulation Control Airfoils in 1960, there have been only 2 aircraft designed and flown with circulation control (CC). Designing with CC is complex for the following reasons: the relation between lift increase and blowing momentum is nonlinear; for good cruise performance one must change the wing geometry in flight from a round to a sharp trailing edge. The bleed air from the propulsion engines or an auxiliary compressor, must be used efficiently. In designing with CC, the propulsion and control aspects are just as important as aerodynamics. These design aspects were examined and linearized equations are presented in order to facilitate a preliminary analysis of the performance potential of CC. The thrust and lift requirements for takeoff make the calculated runway length very sensitive to the bleed air ratio. Thrust vectoring improves performance and can offset nose down pitching moments. The choice of blowing jet to free stream velocity ratio determines the efficiency of applying bleed air power. Author

N88-17611# Naval Postgraduate School, Monterey, Calif.
INVESTIGATION OF DYNAMIC STALL USING LDV (LASER DOPPLER VELOCIMETRY): MEAN FLOW STUDIES M.S. Thesis
Richard Randolph Ryles Sep. 1987 80 p Sponsored in part by Army Research Office and AFOSR
(AD-A187629) Avail: NTIS HC A05/MF A01 CSCL 20D

This thesis lays the foundation for the dynamic stall investigation being conducted at the Fluid Mechanics Laboratory at NASA-Ames Research Center. Using existing optical and electrical equipment, a new dedicated Micro-VAX computer and Labstar software, an Indraft transonic wind tunnel and able technicians to make the proper interface hardware, the project came together in a new test facility at the Fluid Mechanics Laboratory. The goal of the thesis was to obtain both qualitative and quantitative information about the wake profiles of an airfoil in steady state operations at varying angles of attack and tunnel conditions. To accomplish this task, schlieren photography was used to obtain a qualitative picture of the flow field. With this information, a two component Laser Doppler Velocimeter was set up to accurately measure the velocity profiles that correspond to the schlieren photographs. Once this preliminary work is completed, the same apparatus will be used to further investigate the unsteady dynamic stall phenomenon. GRA

N88-17612*# Kansas Univ. Center for Research, Inc., Lawrence. Flight Research Lab.
CALCULATION OF AERODYNAMIC CHARACTERISTICS OF AIRPLANE CONFIGURATIONS AT HIGH ANGLES OF ATTACK Final Report
J. B. Tseng and C. Edward Lan Sep. 1987 115 p
(Grant NAG1-635)
(NASA-CR-182541; NAS 1.26:182541; CRINC-FRL-730-1) Avail: NTIS HC A06/MF A01 CSCL 01A

Calculation of the longitudinal and lateral-directional aerodynamic characteristics of airplanes by the VORSTAB code is examined. The numerical predictions are based on the potential flow theory with the corrections of high angle-of-attack phenomena, i.e., vortex flow and boundary layer separation effects. To account for the vortex flow effect, vortex lift, vortex action point, augmented vortex lift, and vortex breakdown effect through the method of suction analogy are included. The effect of boundary layer separation is obtained by matching the nonlinear section data with the 3-D lift characteristics iteratively. Through correlation with results for nine fighter configurations, it is concluded that reasonably accurate prediction of longitudinal and static lateral-directional aerodynamics can be obtained with the VORSTAB code up to an angle of attack at which wake interference and forebody vortex effect are not important. Possible reasons for discrepancy at high angles of attack are discussed. Author

N88-17613# National Aerospace Lab., Tokyo (Japan).
LIFTING-SURFACE THEORY OF OSCILLATING PROPELLERS IN COMPRESSIBLE FLOW
Teruo Ichikawa Aug. 1987 25 p In JAPANESE; ENGLISH summary
(NAL-TR-943; ISSN-0389-4010) Avail: NTIS HC A03/MF A01

Linear simultaneous integral equations are derived for computing aerodynamic loads of oscillating propellers in a compressible flow. It is shown that the integral over the boundary surface at infinity in Green's formula vanishes by virtue of conditions at infinity which must be satisfied by the acceleration potential and the fundamental solution of the adjoint governing equation. A study is also made on the Mach cone in supersonic sections regarded as a characteristic surface belonging to the steady case governing differential equation. This makes it possible to distinguish subsonic and supersonic trailing edges. Author

N88-17614*# National Aeronautics and Space Administration. Langley Research Center, Hampton, Va.
A TRANSONIC-SMALL-DISTURBANCE WING DESIGN METHODOLOGY
Pamela S. Phillips, Edgar G. Waggoner, and Richard L. Campbell Mar. 1988 32 p
(NASA-TP-2806; L-16393; NAS 1.60:2806) Avail: NTIS HC A03/MF A01 CSCL 01A

An automated transonic design code has been developed which modifies an initial airfoil or wing in order to generate a specified pressure distribution. The design method uses an iterative approach that alternates between a potential-flow analysis and a design algorithm that relates changes in surface pressure to changes in geometry. The analysis code solves an extended small-disturbance potential-flow equation and can model a fuselage, pylons, nacelles, and a winglet in addition to the wing. A two-dimensional option is available for airfoil analysis and design. Several two- and three-dimensional test cases illustrate the capabilities of the design code. Author

N88-17615*# National Aeronautics and Space Administration. Langley Research Center, Hampton, Va.
SUPERSONIC AERODYNAMICS OF DELTA WINGS
Richard M. Wood Mar. 1988 106 p
(NASA-TP-2771; L-16212; NAS 1.60:2771) Avail: NTIS HC A06/MF A01 CSCL 01A

Through the empirical correlation of experimental data and theoretical analysis, a set of graphs has been developed which summarize the inviscid aerodynamics of delta wings at supersonic speeds. The various graphs which detail the aerodynamic performance of delta wings at both zero-lift and lifting conditions were then employed to define a preliminary wing design approach in which both the low-lift and high-lift design criteria were combined to define a feasible design space. Author

N88-17831# Boelkow-Entwicklingen K.G., Stuttgart (West Germany). Abteilung Flugmechanik.
DETERMINATION OF THE DRAG OF MISSILES WITH VARIABLE LATERAL ACCELERATION POSSIBILITY [ERMITTLUNG DER WIDERSTAENDE FUER FLUGKOERPER MIT VERAENDERTER SEITENBESCHLEUNIGUNGSMOEGLICHKEIT]
Otto E. Pabst *In* MBB GmbH, Research and Development. Technical-Scientific Publications (1956-1987): Retrospective View and Prospects. Jubilee Edition on the Occasion of the 75th Anniversary of Dipl.-Engr. Dr.-Engr. E.H. Ludwig Boelkow 1987 p 87-92 In GERMAN (For primary document see N88-17819 10-31)
(Rept-FM15) Copyright Avail: NTIS HC A14/MF A01

N88-17859# Messerschmitt-Boelkow-Blohm G.m.b.H., Ottobrunn (West Germany). Space Systems Group.
THREE-DIMENSIONAL EULER SOLUTIONS FOR HYPERSONIC MACH NUMBERS
Michael Pfitzner and Claus Weiland *In its* Research and Development. Technical-Scientific Publications (1956-1987): Retrospective View and Prospects. Jubilee Edition on the Occasion of the 75th Anniversary of Dipl.-Engr. Dr.-Engr. E.H. Ludwig Boeklow 1987 p 263-272 Presented at the AGARD Conference on Aerodynamics of Hypersonic Lifting Vehicles, Bristol, United Kingdom, 6-7 Sep. 1987 (For primary document see N88-17819 10-31)
(MBB-UR-944/87) Copyright Avail: NTIS HC A14/MF A01

03 AIR TRANSPORTATION AND SAFETY

Includes passenger and cargo air transport operations; and aircraft accidents.

For related information see also *16 Space Transportation* and *85 Urban Technology and Transportation.*

N88-17616*# National Aeronautics and Space Administration. Langley Research Center, Hampton, Va.
AIRBORNE WIND SHEAR DETECTION AND WARNING SYSTEMS: FIRST COMBINED MANUFACTURERS' AND TECHNOLOGISTS' CONFERENCE
Amos A. Spady, Jr., comp., Roland L. Bowles, comp., and Herbert Schlickenmaier, comp. (Federal Aviation Administration, Washington, D.C.) Jan. 1988 558 p Conference held in Hampton, Va., 22-23 Oct. 1987
(NASA-CP-10006; NAS 1.55:10006; DOT/FAA/PS-88/7) Avail: NTIS HC A24/MF A01 CSCL 01C

The purpose of the meeting was to transfer significant, ongoing results gained during the first year of the joint NASA/FAA Airborne Wind Shear Program to the technical industry and to pose problems of current concern to the combined group. It also provided a forum for manufacturers to review forward-looking technology concepts and for technologists to gain an understanding of FAA certification requirements and the problems encountered by the manufacturers during the development of airborne equipment. For individual titles, see N88-17617 through N88-17636.

N88-17617*# Mesoscale Environmental Simulations, Inc., Hampton, Va.
NASA WIND SHEAR MODEL: SUMMARY OF MODEL ANALYSES c47
Fred Proctor *In* NASA. Langley Research Center, Airborne Wind Shear Detection and Warning Systems: First Combined Manufacturers and Technologists Conference Jan. 1988 p 29-66 (For primary document see N88-17616 10-03)
Avail: NTIS HC A24/MF A01 CSCL 04B

A summary of an analysis of a wind shear model is presented in the form of vugraphs. Information is given on the Terminal Area Simulation System, two dimensional axisymmetric simulations, precipitation, ambient temperature and humidity profiles over Denver, and the structure of microbursts. It was concluded that the intensity of microbursts depends upon the environment temperature and humidity profile, the diameter of the microburst downdraft, the type of precipitation and the precipitation rate. The depth of the outflow layer depends primarily upon the diameter of the downdraft. Dry microbursts are more likely to be produced by precipitation initially falling as snow. R.J.F.

N88-17618*# National Aeronautics and Space Administration. Langley Research Center, Hampton, Va.
RESPONSE OF WIND SHEAR WARNING SYSTEMS TO TURBULENCE WITH IMPLICATION OF NUISANCE ALERTS
Roland L. Bowles *In its* Airborne Wind Shear Detection and Warning Systems: First Combined Manufacturers and Technologists Conference Jan. 1988 p 67-86 (For primary document see N88-17616 10-03)
Avail: NTIS HC A24/MF A01 CSCL 01C

The objective was to predict the inherent turbulence response characteristics of candidate wind shear warning system concepts and to assess the potential for nuisance alerts. Information on the detection system and associated signal processing, physical and mathematical models, wind shear factor root mean square turbulence response and the standard deviation of the wind shear factor due to turbulence is given in vugraph form. R.J.F.

N88-17619*# National Aeronautics and Space Administration. Langley Research Center, Hampton, Va.
INVESTIGATION OF THE INFLUENCE OF WIND SHEAR ON THE AERODYNAMIC CHARACTERISTICS OF AIRCRAFT USING A VORTEX-LATTICE METHOD
Dan D. Vicroy *In its* Airborne Wind Shear Detection and Warning Systems: First Combined Manufacturers and Technologists Conference Jan. 1988 p 91-136 (For primary document see N88-17616 10-03)
Avail: NTIS HC A24/MF A01 CSCL 01C

The objective was to investigate and characterize the aerodynamic effect of shear flow through a series of sensitivity studies of the wind velocity gradients and wing planform geometry parameters. The wind shear effect was computed using a modified vortex-lattice computer program and characterized through the formulation of wind shear aerodynamic coefficients. The magnitude of the aerodynamic effect was demonstrated by computing the resultant change in the aerodynamics of a conventional wing and tail combination on a fixed flight path through a simulated microburst. The results of the study indicate that a significant amount of the control authority of an airplane may be required to counteract the wind shear induced forces and moments in the microburst environment. Author

N88-17620*# National Aeronautics and Space Administration. Langley Research Center, Hampton, Va.
WINDSHEAR WARNING AEROSPATIALE APPROACH
J. L. Bonafe *In its* Airborne Wind Shear Detection and Warning Systems: First Combined Manufacturers and Technologists Conference Jan. 1988 p 137-163 (For primary document see N88-17616 10-03)
Avail: NTIS HC A24/MF A01 CSCL 01C

Vugraphs and transcribed remarks of a presentation on Aerospatiale's approach to windshear warning systems are given. Information is given on low altitude wind shear probability, wind shear warning models and warning system false alarms. R.J.F.

N88-17621*# Sundstrand Data Control, Inc., Redmond, Wash.
WINDSHEAR DETECTION EFFECT OF STATIC AIR TEMPERATURE BIAS
Howard Glover *In* NASA. Langley Research Center, Airborne Wind Shear Detection and Warning Systems: First Combined Manufacturers and Technologists Conference Jan. 1988 p 165-175 (For primary document see N88-17616 10-03)
Avail: NTIS HC A24/MF A01 CSCL 01C

Data in vugraph form is given on vertical winds, atmospheric temperature bias output and simulation with and without temperature bias. A block diagram of a windshear detection algorithm is given. R.J.F.

N88-17622*# National Aeronautics and Space Administration. Langley Research Center, Hampton, Va.
AIRBORNE DOPPLER RADAR TECHNOLOGY FOR WIND SHEAR DETECTION
In its Airborne Wind Shear Detection and Warning Systems: First Combined Manufacturers and Technologists Conference Jan. 1988 p 177-181 (For primary document see N88-17616 10-03)
Avail: NTIS HC A24/MF A01 CSCL 01C

The objectives of the Airborne Doppler Radar Technology Development Program, the technical approach and program status are given in vugraph form. R.J.F.

N88-17623*# Environmental Research Inst. of Michigan, Ann Arbor. Radar Science Lab.
RADAR BACKSCATTER FROM AIRPORTS AND SURROUNDING AREAS c32
Robert G. Onstott *In* NASA. Langley Research Center, Airborne Wind Shear Detection and Warning Systems: First Combined Manufacturers and Technologists Conference Jan. 1988 p 183-191 (For primary document see N88-17616 10-03)
Avail: NTIS HC A24/MF A01 CSCL 17B

Vugraphs used in a presentation to describe the ground clutter environment at or near airports are given. R.J.F.

N88-17624*# Northeastern Univ., Boston, Mass.
RADAR RETURNS FROM GROUND CLUTTER IN VICINITY OF AIRPORTS c32
H. R. Raemer, R. Rahgavan, and A. Bhattacharya *In* NASA. Langley Research Center, Airborne Wind Shear Detection and Warning Systems: First Combined Manufacturers and Technologists Conference Jan. 1988 p 193-205 (For primary document see N88-17616 10-03)
Avail: NTIS HC A24/MF A01 CSCL 17B

The objective of this project is to develop a dynamic simulation of the received signals from natural and man-made ground features in the vicinity of airports. The simulation is run during landing and takeoff stages of a flight. Vugraphs of noteworthy features of the simulation, ground clutter data bases, the development of algorithms for terrain features, typical wave theory results, and a gravity wave height profile are given. R.J.F.

N88-17625*# Research Triangle Inst., Hampton, Va.
WIND SHEAR RADAR SIMULATION c32
Charles L. Britt *In* NASA. Langley Research Center, Airborne Wind Shear Detection and Warning Systems: First Combined Manufacturers and Technologists Conference Jan. 1988 p 207-231 (For primary document see N88-17616 10-03)
Avail: NTIS HC A24/MF A01 CSCL 17B

Viewgraphs used in a presentation on wind shear radar simulation are given. Information on a microburst model of radar reflectivity and wind velocity, radar pulse output, the calculation of radar return, microburst power spectrum, and simulation plans are given. A question and answer session is transcribed. R.J.F.

N88-17626*# National Aeronautics and Space Administration. Langley Research Center, Hampton, Va. Research Development Div.
LIDAR WINDSHEAR DETECTION AND AVOIDANCE: PERFORMANCE AND TECHNICAL ASSESSMENT
Russell Targ *In its* Airborne Wind Shear Detection and Warning Systems: First Combined Manufacturers and Technologists Conference Jan. 1988 p 233-252 (For primary document see N88-17616 10-03)
Avail: NTIS HC A24/MF A01 CSCL 01C

The objective of this study is to evaluate competing lidars for use in an airborne forward-looking system to enable aircraft to avoid the hazards of low altitude wind shear. Information is presented in vugraph form on lidar general requirements, tentative technical requirements, comparison of velocity errors and signal to noise ratios in clear weather for 2.1 and 10.6 micron lidars, a wind shear display, and preliminary results. R.J.F.

N88-17627*# Coherent Technologies, Inc., Boulder, Colo.
AIRBORNE DOPPLER LIDAR DETECTION OF WIND SHEAR. RESULTS OF PERFORMANCE ANALYSIS
R. Milton Huffaker *In* NASA. Langley Research Center, Airborne Wind Shear Detection and Warning Systems: First Combined Manufacturers and Technologists Conference Jan. 1988 p 253-282 (For primary document see N88-17616 10-03)
Avail: NTIS HC A24/MF A01 CSCL 01C

Results of a performance analysis of an airborne Doppler radar wind shear detection system are given in vugraph form. It was concluded that both CO sub 2 and Ho:YAG lasers are feasible for dry microburst applications, but with limited performance in wet microbursts. The Ho:YAG performs better than the CO sub 2 for a set of identical lidar parameters. R.J.F.

N88-17628*# Turbulence Prediction Systems, Boulder, Colo.
INFRARED LOW-LEVEL WIND SHEAR WORK
Pat Adamson *In* NASA. Langley Research Center, Airborne Wind Shear Detection and Warning Systems: First Combined Manufacturers and Technologists Conference Jan. 1988 p 283-321 (For primary document see N88-17616 10-03)
Avail: NTIS HC A24/MF A01 CSCL 01C

Results of field experiments for the detection of clear air disturbance and low level wind shear utilizing an infrared airborne system are given in vugraph form. The hits, misses and nuisance alarms scores are given. Information is given on the infrared spatial resolution technique. The popular index of aircraft hazard (F= WX over g - VN over AS) is developed for a remote temperature sensor. R.J.F.

N88-17629*# Delco Systems Operations, Milwaukee, Wis.
FORWARD LOOKING WIND SHEAR DETECTION Status Report, 22 Oct. 1987
In NASA. Langley Research Center, Airborne Wind Shear Detection and Warning Systems: First Combined Manufacturers and Technologists Conference Jan. 1988 p 323-334 (For primary document see N88-17616 10-03)
Avail: NTIS HC A24/MF A01 CSCL 01C

Information on forward looking wind shear detection is presented in vugraph form. Information is given on system concept development, signal characterization, the field test program, typical radiance fluctuations vs time and radiometric temperatures vs azimuth headings. R.J.F.

N88-17630*# National Aeronautics and Space Administration. Langley Research Center, Hampton, Va.
SIMULATOR INVESTIGATION OF WIND SHEAR RECOVERY TECHNIQUES M.S. Thesis - George Washington Univ.
David A. Hinton *In its* Airborne Wind Shear Detection and Warning Systems: First Combined Manufacturers and Technologists Conference Jan. 1988 p 335-363 (For primary document see N88-17616 10-03)
Avail: NTIS HC A24/MF A01 CSCL 01C

The objective was the development of practical flight procedures and guidance for near-optimal trajectories during inadvertent wind shear encounters following takeoff. The approach was to conduct preliminary development of candidate strategies using batch simulation of the point mass B737-100 performance model and to evaluate candidate guidance strategies in piloted, real time, six degrees of freedom simulation. R.J.F.

N88-17631*# Boeing Commercial Airplane Co., Seattle, Wash. Flight Deck Research.
CREW INTERFACE WITH WINDSHEAR SYSTEMS
Dave Carbaugh *In* NASA. Langley Research Center, Airborne Wind Shear Detection and Warning Systems: First Combined Manufacturers and Technologists Conference Jan. 1988 p 365-397 (For primary document see N88-17616 10-03)
Avail: NTIS HC A24/MF A01 CSCL 01C

A review is given of the areas within Boeing that are working on the NASA contract to conduct windshear studies. A synopsis is given of the work that Boeing Flight Deck Research is doing. A short review of nuisance and alerts is given in light of upcoming forward look technology. R.J.F.

N88-17632*# Massachusetts Inst. of Tech., Lexington.
STATUS OF FAA TERMINAL DOPPLER WEATHER RADAR PROGRAMS **c32**
Mark W. Merritt *In* NASA. Langley Research Center, Airborne Wind Shear Detection and Warning Systems: First Combined Manufacturers and Technologists Conference Jan. 1988 p 411-444 (For primary document see N88-17616 10-03)
Avail: NTIS HC A24/MF A01 CSCL 17I

The status of the Federal Aviation Administration (FAA) Doppler weather radar programs are presented in vugraph form. Abstracts of relevant reports are given. R.J.F.

N88-17633*# National Center for Atmospheric Research, Boulder, Colo. Atmospheric Technology Div.
THE ADVANCED LOW-LEVEL WINDSHEAR ALERT SYSTEM OPERATIONAL DEMONSTRATION RESULTS, SUMMER, 1987, DENVER STAPLETON INTERNATIONAL AIRPORT
James Moore *In* NASA. Langley Research Center, Airborne Wind Shear Detection and Warning Systems: First Combined Manufacturers and Technologists Conference Jan. 1988 p 481-506 (For primary document see N88-17616 10-03)
Avail: NTIS HC A24/MF A01 CSCL 01C

Operational results of the Advanced Low-Level Windshear Alert System operational demonstration results are presented in vugraph form and are followed by a transcribed question and answer session. R.J.F.

N88-17634*# National Aeronautics and Space Administration. Ames Research Center, Moffett Field, Calif.
INFORMATION TRANSFER IN THE NATIONAL AIRSPACE SYSTEM **c82**
Alfred T. Lee *In* NASA. Langley Research Center, Airborne Wind Shear Detection and Warning Systems: First Combined Manufacturers and Technologists Conference Jan. 1988 p 507-515 (For primary document see N88-17616 10-03)
Avail: NTIS HC A24/MF A01 CSCL 05B

An informal overview is given of the work in progress and the planned work in the area of information transfer that specifically addresses human factors issues in National Airspace System (NAS). The issues of how weather information will be displayed on the flight deck, the development of appropriate decision making technology, and digital datalink transmission are also briefly discussed. R.J.F.

N88-17635*# National Aeronautics and Space Administration. Ames Research Center, Moffett Field, Calif.
ARE WINDSHEAR TRAINING AID RECOMMENDATIONS APPROPRIATE FOR OTHER THAN LARGE JET TRANSPORTS? PILOT PROCEDURES: SHEAR MODELS
R. S. Bray *In* NASA. Langley Research Center, Airborne Wind Shear Detection and Warning Systems: First Combined Manufacturers and Technologists Conference Jan. 1988 p 517-524 (For primary document see N88-17616 10-03)
Avail: NTIS HC A24/MF A01 CSCL 01C

Information is given in vugraph form on pilot procedures in windshear, typical winds in a downburst, a downburst encounter at takeoff by a large jet transport and a light turboprop twin, and a comparison of pitch algorithms in an approach encounter with downburst shear. It is observed that the light turboprop appears no less tolerant of a downburst encounter than the large jet. R.J.F.

N88-17636*# Federal Aviation Administration, Seattle, Wash.
AIRWORTHINESS CONSIDERATIONS
Ray Stoer *In* NASA. Langley Research Center, Airborne Wind Shear Detection and Warning Systems: First Combined Manufacturers and Technologists Conference Jan. 1988 p 525-531 (For primary document see N88-17616 10-03)
Avail: NTIS HC A24/MF A01 CSCL 01C

Guidance is provided for the airworthiness approval of both annunciation only and annunciation with guidance airborne windshear warning systems. Characteristics of a comprehensive certification plan, the criticality of certain system failure cases for windshear warning with and without escape guidance, software based systems, and probability analysis are among the topics covered. R.J.F.

N88-17637# Boeing Co., Seattle, Wash.
WINDSHEAR TRAINING AID. VOLUME 1: OVERVIEW, PILOT GUIDE, TRAINING PROGRAM Final Report
Feb. 1987 615 p
(Contract DTFA01-86-C-00005)
(PB88-127196) Avail: NTIS HC A99/MF A01 CSCL 01C

Windshear is defined as a sudden change in wind direction and/or speed over a relatively short distance. It can be especially hazardous is encountered at low altitude when an aircraft if taking off or landing and has neither the altitude nor airspeed to recover. The training aid has two important objectives: training for recognition and avoidance of weather phenomena that cause windshear and cockpit recognition and recovery techniques. The training aid stresses that avoidance of windshear is a pilot's best defense. To this end, it puts heavy emphasis on recognizing the meteorological clues that indicate the possible existence of low level windshear and the need for pilots to base their operational decisions on this information. When a pilot is caught in windshear, the training aid notes that a pilot has only limited time to recognize the problem and begin recovery. Author

N88-17638# National Transportation Safety Board, Washington, D. C. Bureau of Safety Program.
ANNUAL REVIEW OF AIRCRAFT ACCIDENT DATA: US AIR CARRIER OPERATIONS CALENDAR YEAR 1985
27 Nov. 1987 121 p
(PB88-135843; NTSB/ARC-87/03) Avail: NTIS HC A06/MF A01 CSCL 01C

The record of aviation accidents involving revenue operations of U.S. Air Carriers including Commuter Air Carriers and On Demand Air Taxis for calender year 1985 is presented. The report is divided into three major sections according to federal regulations under which the flight was conducted: 14 CFR 121, 125, 127, Scheduled 14 CFR 135, or Nonscheduled 14 CFR 135. In each section of the report tables are presented to describe the losses and characteristics of the 1985 accidents to enable comparison with prior years. Author

N88-17639# National Transportation Safety Board, Washington, D. C. Bureau of Accident Investigation.
AIRCRAFT ACCIDENT/INCIDENT, NEWARK, NEW JERSEY, NOVEMBER 13, 1986 Summary Report
30 Dec. 1987 14 p
(NTSB/AAR-87/04-Summ) Avail: NTIS HC A03/MF A01

A summary is presented of an aircraft accident investigated by the National Transportation Safety Board. The accident location and date is Newark, New Jersey, November 13, 1986. Author

04 AIRCRAFT COMMUNICATIONS AND NAVIGATION

Includes digital and voice communication with aircraft; air navigation systems (satellite and ground based); and air traffic control.

For related information see also *17 Space Communications, Spacecraft Communications, Command and Tracking* and *Communications and Radar.*

N88-17640# Maryland Univ., College Park. Center for Automation Research.
AN OVERVIEW OF VISION-BASED NAVIGATION FOR AUTONOMOUS LAND VEHICLES 1986
Sharat Chandran, Larry S. Davis, Daniel Dementhon, Sven J. Dickenson, and Suresh Gajulapalli Apr. 1987 126 p
(Contract DACA76-84-C-0004)
(AD-A188186; CAR-TR-285; CS-TR-1831; ETL-0479) Avail: NTIS HC A07/MF A01 CSCL 12I

This report describes research performed during the first two years on the project Vision-Based Navigation for Autonomous Vehicles being conducted under DARPA support. The report contains discussion of four main topics: (1) Development of a vision system for autonomous navigation of roads and road network. (2) Support of Martin Marietta Aerospace, Denver, the integrating contractor on DARPA's ALV program. (3) Experimentation with the vision system developed at Maryland on the Martin Marietta ALV, and (4) Development and implementation of parallel algorithms for visual navigation on the parallel computers developed under the DARPA Strategic Computing Program--specifically, the WARP systolic array processor, the Butterfly, and the Connection Machine. GRA

05 AIRCRAFT DESIGN, TESTING AND PERFORMANCE

Includes aircraft simulation technology.

For related information see also *18 Spacecraft Design, Testing and Performance* and *39 Structural Mechanics.* For land transportation vehicles see *85 Urban Technology and Transportation.*

N88-17641# Essex Corp., Alexandria, Va.
HELICOPTER EXTERNAL VISION REQUIREMENTS AND VISUAL DISPLAY CHARACTERISTICS: A REPORT/BIBLIOGRAPHY, REVISION A Final Report
Steven Hale Oct. 1987 28 p
(Contract DAAK11-85-C-0031; DA Proj. 1L1-62716-AH-70)
(AD-A187075; EFR-010-Rev-A; HEL-TN-6-87-Rev-A) Avail: NTIS HC A03/MF A01 CSCL 01C

A literature review was conducted to examine helicopter external vision requirements and related visual display characteristics. Several articles are summarized in annotated bibliography format. A subsequent discussion section addresses the information contained in those articles as well as relevant information contained in other documents. Suggestions are made for future research. GRA

N88-17642# International Technical Associates Ltd., Drexel Hill, Pa.
ROTORCRAFT WEIGHT TRENDS IN LIGHT OF STRUCTURAL MATERIAL CHARACTERISTICS Final Report, 6 Sep. 1984 - 31 May 1987
W. Z. Stepniewski 1987 113 p
(Contract DAAJ09-84-M-0706)
(AD-A186576; AVSCOM-TR-87-A-10) Avail: NTIS HC A06/MF A01 CSCL 01C

Variations in weight of rotorcraft and their major components due to the use of advanced materials are examined. The impact of new materials on component weights is illustrated by historical weight trends. The influences of structural material characteristics on relative weight levels of major rotorcraft components and the

weight effectiveness for both static and fatigue-type loadings are reviewed. Cursory expressions are developed to permit estimation of how the strength effectiveness values or structural materials affect the relative weights of components. Special constraints which could limit the possible weight reductions achievable are considered briefly. A survey of advanced structural materials is also included. GRA

N88-17643 Stanford Univ., Calif.
FREQUENCY-RESPONSE IDENTIFICATION OF XV-15 TILT-ROTOR AIRCRAFT DYNAMICS Ph.D. Thesis
Mark B. Tischler [1987] 191 p
Avail: Univ. Microfilms Order No. DA8723101

The timely design and development of the next generation of tilt-rotor aircraft (JVX) depend heavily on the in-depth understanding of existing XV-15 dynamics and the availability of fully validated simulation models. The objectives of this study include the following: documentation and evaluation of XV-15 bare-airframe dynamics; comparison of aircraft and simulation responses; and development of a validated transfer function description of the XV-15 needed for future studies. A nonparametric frequency response approach is used which does not depend on assumed model order or structure. Transfer function representations are subsequently derived which fit the frequency-responses in the bandwidth of greatest concern for piloted handling-qualities and control-system applications. Flight tests on the XV-15 aircraft and piloted-simulation for four flight conditions from hover to cruise were planned and executed. Improved test techniques and pilot-training procedures were devised. Analytical software tools were developed which allow the identification of high-resolution spectral responses and the derivation and validation of multi-input/multi-output transfer function models. These techniques were applied in an extensive evaluation of the open-loop flight dynamics of the XV-15 aircraft and simulation mathematical models. Deficiencies were exposed and documented. A new, fully validated transfer function model was then derived for hover and cruise flight conditions. Dissert. Abstr.

N88-17644*# National Aeronautics and Space Administration. Ames Research Center, Moffett Field, Calif.
X-29A FORWARD-SWEPT-WING FLIGHT RESEARCH PROGRAM STATUS
Gary A. Trippensee and David P. Lux Nov. 1987 11 p Presented at the SAE International Pacific Air and Space Technology Conference, Melbourne, Australia, 13-17 Nov. 1987
(NASA-TM-100413; H-1432; NAS 1.15:100413) Avail: NTIS HC A03/MF A01 CSCL 01C

The X-29A aircraft is a fascinating combination of integrated technologies incorporated into a unique research aircraft. The X-29A program is multiple agency program with management and other responsibilities divided among NASA, DARPA, the U.S. Air Force, and the Grumman Corporation. An overview of the recently completed X-29A flight research program, objectives achieved, and a discussion of its future is presented. Also discussed are the flight test approach expanding the envelope, typical flight maneuvers performed, X-29A program accomplishments, lessons learned for the Number One aircraft, and future plans with the Number Two aircraft. A schedule for both aircraft is presented. A description of the unique technologies incorporated into the X-29A aircraft is given, along with descriptions of the onboard instrumentation system. The X-29A aircraft research program has proven highly successful. Using high fly rates from a very reliable experimental aircraft, the program has consistently met or exceeded its design and research goals. Author

N88-17645*# National Aeronautics and Space Administration. Ames Research Center, Moffett Field, Calif.
TRANSPORT DELAY COMPENSATION FOR COMPUTER-GENERATED IMAGERY SYSTEMS
Richard E. McFarland Jan. 1988 29 p
(NASA-TM-100084; A-87385; NAS 1.15:100084) Avail: NTIS HC A03/MF A01 CSCL 01C

In the problem of pure transport delay in a low-pass system, a trade-off exists with respect to performance within and beyond a frequency bandwidth. When activity beyond the band is attenuated because of other considerations, this trade-off may be used to improve the performance within the band. Specifically, transport delay in computer-generated imagery systems is reduced to a manageable problem by recognizing frequency limits in vehicle activity and manual-control capacity. Based on these limits, a compensation algorithm has been developed for use in aircraft simulation at NASA Ames Research Center. For direct measurement of transport delays, a beam-splitter experiment is presented that accounts for the complete flight simulation environment. Values determined by this experiment are appropriate for use in the compensation algorithm. The algorithm extends the bandwidth of high-frequency flight simulation to well beyond that of normal pilot inputs. Within this bandwidth, the visual scene presentation manifests negligible gain distortion and phase lag. After a year of utilization, two minor exceptions to universal simulation applicability have been identified and subsequently resolved. Author

N88-17646*# National Aeronautics and Space Administration. Ames Research Center, Moffett Field, Calif.
USING FREQUENCY-DOMAIN METHODS TO IDENTIFY XV-15 AEROELASTIC MODES
C. W. Acree, Jr. and Mark B. Tischler (Army Aviation Research and Development Command, Moffett Field, Calif.) Nov. 1987 25 p
(NASA-TM-100033; A-87364; NAS 1.15:100033; USAAVSCOM-TR-87-A-17) Avail: NTIS HC A03/MF A01 CSCL 01C

The XV-15 Tilt-Rotor wing has six major aeroelastic modes that are close in frequency. To precisely excite individual modes during flight test, dual flaperon exciters with automatic frequency-sweep controls were installed. The resulting structural data were analyzed in the frequency domain (Fourier transformed) with cross spectral and transfer function methods. Modal frequencies and damping were determined by performing curve fits to transfer function magnitude and phase data and to cross spectral magnitude data. Results are given for the XV-15 with its original metal rotor blades. Frequency and damping values are also compared with earlier predictions. Author

N88-17608*# Lockheed-Georgia Co., Marietta. Advanced Flight Sciences Dept.
DEVELOPMENT OF CIRCULATION CONTROL TECHNOLOGY FOR POWERED-LIFT STOL AIRCRAFT
Robert J. Englar *In* NASA. Ames Research Center Proceedings of the Circulation-Control Workshop, 1986 May 1987 p 491-537 (For primary document see N88-17586 10-02)
Avail: NTIS HC A25/MF A01 CSCL 01C

N88-17609*# National Aeronautics and Space Administration. Ames Research Center, Moffett Field, Calif.
A POTENTIAL FLIGHT EVALUATION OF AN UPPER-SURFACE-BLOWING/CIRCULATION-CONTROL-WING CONCEPT
Dennis W. Riddle and Joseph C. Eppel *In its* Proceedings of the Circulation-Control Workshop, 1986 May 1987 p 539-567 (For primary document see N88-17586 10-02)
Avail: NTIS HC A25/MF A01 CSCL 01C

N88-17822# Entwicklungsring Sud, Munich (West Germany). Projektabteilung.
DEVELOPMENT OF VERTICAL TAKEOFF AIRCRAFT WITH TURBOJET ENGINES IN GERMANY [DIE ENTWICKLUNG VON SENKRECHTSTARTFLUGZEUGEN MIT TURBINENSTRAHL-TRIEBWERKEN IN DEUTSCHLAND]
Karl Schwaerzler *In* MBB GmbH, Research and Development. Technical-Scientific Publications (1956-1987): Retrospective View and Prospects. Jubilee Edition on the Occasion of the 75th Anniversary of Dipl.-Engr. Dr.-Engr. E.H. Ludwig Boelkow 1987 p 33-40 In GERMAN (For primary document see N88-17819 10-31)
Copyright Avail: NTIS HC A14/MF A01

N88-17823# Entwicklungsring Sud, Munich (West Germany). Projektabteilung.
VARIABLE SWEEP WINGS [VARIABLE PFEILUNG DES FLUEGELS]
Helmut Langfelder *In* MBB GmbH, Research and Development. Technical-Scientific Publications (1956-1987): Retrospective View and Prospects. Jubilee Edition on the Occasion of the 75th Anniversary of Dipl.-Engr. Dr.-Engr. E.H. Ludwig Boelkow 1987 p 41-46 In GERMAN Presented at the 6th Europaeischen Luftfahrtkongress, Munich, Fed. Republic of Germany, 1-4 Sep. 1965 (For primary document see N88-17819 10-31)
Copyright Avail: NTIS HC A14/MF A01

N88-17824# Deutsche Airbus G.m.b.H., Munich (West Germany). Technische Geschaeftsfuehrung.
THE EUROPEAN AIRBUS A-300 [DER EUROPAEISCHE AIRBUS A 300]
Hans Wocke *In* MBB GmbH Research and Development. Technical-Scientific Publications (1956-1987): Retrospective View and Prospects. Jubilee Edition on the Occasion of the 75th Anniversary of Dipl.-Engr. Dr.-Engr. E.H. Ludwig Boelkow 1987 p 47-50 In GERMAN Presented at the WGLR/DGRR-Jahrestagung, Karlsruhe, Fed. Republic of Germany, Oct. 1967 (For primary document see N88-17819 10-31)
Copyright Avail: NTIS HC A14/MF A01

N88-17825# Messerschmitt-Boelkow-Blohm G.m.b.H., Ottobrunn (West Germany). Projektabteilung.
SPECIAL FLIGHT MECHANICAL FEATURES OF THE BEARINGLESS HELICOPTER ROTOR [FLUGMECHANISCHE BESONDERHEITEN DES GELENKLOSEN HUBSCHRAUBER-ROTORS]
Guenter Reichert *In its* Research and Development. Technical-Scientific Publications (1956-1987): Retrospective View and Prospects. Jubilee Edition on the Occasion of the 75th Anniversary of Dipl.-Engr. Dr.-Engr. E.H. Ludwig Boelkow 1987 p 51-58 In GERMAN Presented at the 6th WGLR Europaeischen Luftfahrtkongress, Munich, Fed. Republic of Germany, 1-4 Sep. 1965 (For primary document see N88-17819 10-31)
(MBB-FM-315/O) Copyright Avail: NTIS HC A14/MF A01

N88-17839# Messerschmitt-Boelkow-Blohm G.m.b.H., Ottobrunn (West Germany). Abteilung Technologie-Entwicklungen.
MODERN MATERIALS FOR LIGHT CONSTRUCTIONS [MODERNE WERKSTOFFE FUER DEN LEICHTBAU]
Juergen Brandt, Helmut Kellerer, and Peter J. Winkler *In its* Research and Development. Technical-Scientific Publications (1956-1987): Retrospective View and Prospects. Jubilee Edition on the Occasion of the 75th Anniversary of Dipl.-Engr. Dr.-Engr. E.H. Ludwig Boelkow 1987 p 131-134 In GERMAN (For primary document see N88-17819 10-31)
(MBB-Z-136/86) Copyright Avail: NTIS HC A14/MF A01

N88-17842# Messerschmitt-Boelkow-Blohm G.m.b.H., Ottobrunn (West Germany). Unternehmensgruppe Hubschrauber und Flugzeuge.
PURPOSES AND TASKS OF HIGH-PERFORMANCE AIRCRAFT CONSTRUCTION [ZIELE UND AUFGABEN DES HOCHLEISTUNGSFLUGZEUGBAUS]
Oskar Friedrich *In its* Research and Development. Technical-Scientific Publications (1956-1987): Retrospective View and Prospects. Jubilee Edition on the Occasion of the 75th Anniversary of Dipl.-Engr. Dr.-Engr. E.H. Ludwig Boelkow 1987 p 147-150 In GERMAN (For primary document see N88-17819 10-31)
(MBB/LK-S/PUB/296) Copyright Avail: NTIS HC A14/MF A01

N88-17843# Messerschmitt-Boelkow-Blohm G.m.b.H., Ottobrunn (West Germany). Helicopter and Military Aircraft Group.
FUTURE FIGHTER MANEUVERABILITY FOR AIR COMBAT
Wolfgang B. Herbst *In its* Research and Development. Technical-Scientific Publications (1956-1987): Retrospective View and Prospects. Jubilee Edition on the Occasion of the 75th Anniversary of Dipl.-Engr. Dr.-Engr. E.H. Ludwig Boelkow 1987 p 151-156 Presented at the AIAA Aircraft Design Systems and Operations Meeting, Fort Worth, Tex., 17-19 Oct. 1983 (For primary document see N88-17819 10-31)
(MBB/LKE-1/S/PUB/120) Copyright Avail: NTIS HC A14/MF A01

N88-17844# Messerschmitt-Boelkow-Blohm G.m.b.H., Ottobrunn (West Germany). Helicopter and Military Aircraft Group.
FLIGHT TESTING OF FIGHTER AIRCRAFT
Arnim Knaus *In its* Research and Development. Technical-Scientific Publications (1956-1987): Retrospective View and Prospects. Jubilee Edition on the Occasion of the 75th Anniversary of Dipl.-Engr. Dr.-Engr. E.H. Ludwig Boelkow 1987 p 157-166 (For primary document see N88-17819 10-31)
(MBB/LKE-62/S/PUB/292) Copyright Avail: NTIS HC A14/MF A01

N88-17848# Messerschmitt-Boelkow-Blohm G.m.b.H., Bremen (West Germany). Unternehmensgruppe Transport- und Verkehrsflugzeuge.
THE INTELLIGENT WING. AERODYNAMIC DEVELOPMENT DIRECTION FOR FUTURE PASSENGER AIRCRAFT [DER INTELLIGENTE TRAGFLUEGEL - AERODYNAMISCHE ENTWICKLUNGSRICHTUNGEN FUER ZUKUENFTIGE VERKEHRSFLUGZEUGE]
Reinhard Hilbig and Joachim Szodruch *In its* Research and Development. Technical-Scientific Publications (1956-1987): Retrospective View and Prospects. Jubilee Edition on the Occasion of the 75th Anniversary of Dipl.-Engr. Dr.-Engr. E.H. Ludwig Boelkow 1987 p 183-186 In GERMAN (For primary document see N88-17819 10-31)
(MBB-UT-006/87) Copyright Avail: NTIS HC A14/MF A01

N88-17850# Messerschmitt-Boelkow-Blohm G.m.b.H., Bremen (West Germany). Unternehmensgruppe Transport- und Verkehrsflugzeuge.
THE APPLICATION OF MODERN AEROELASTIC DEVELOPMENTS FOR FUTURE PROJECTS [DIE ANWENDUNG MODERNER AEROELASTISCHER ENTWICKLUNGEN FUER ZUKUENFTIGE PROJEKTE]
Helmut Zimmermann and Jens Hinrichsen *In its* Research and Development. Technical-Scientific Publications (1956-1987): Retrospective View and Prospects. Jubilee Edition on the Occasion of the 75th Anniversary of Dipl.-Engr. Dr.-Engr. E.H. Ludwig Boelkow 1987 p 197-202 In GERMAN (For primary document see N88-17819 10-31)
(MBB-UT-007/87) Copyright Avail: NTIS HC A14/MF A01

N88-17853# Messerschmitt-Boelkow-Blohm G.m.b.H., Ottobrunn (West Germany). Helicopter and Military Aircraft Group.
HELICOPTER ACTIVITIES IN GERMANY
Volker vonTein *In its* Research and Development. Technical-Scientific Publications (1956-1987): Retrospective View and Prospects. Jubilee Edition on the Occasion of the 75th Anniversary of Dipl.-Engr. Dr.-Engr. E.H. Ludwig Boelkow 1987 p 213-224 Presented at the 12th European Rotorcraft Forum, Garmisch-Partenkirchen, Fed. Republic of Germany, 22-25 Sep. 1986 Previously announced in IAA as A87-43401 (For primary document see N88-17819 10-31)
(MBB-UD-487/86) Copyright Avail: NTIS HC A14/MF A01

N88-17854# Messerschmitt-Boelkow-Blohm G.m.b.H., Ottobrunn (West Germany). Unternehmensgruppe Hubschrauber und Flugzeuge.
TESTING OF A TAIL ROTOR SYSTEM IN A FIBER COMPOSITE TYPE OF CONSTRUCTION [ERPROBUNG EINES HECKROTORSYSTEMES IN FASERVERBUNDBAUWEISE]
Valenti Kloeppel and Bernhard Enenkel *In its* Research and Development. Technical-Scientific Publications (1956-1987): Retrospective View and Prospects. Jubilee Edition on the Occasion of the 75th Anniversary of Dipl.-Engr. Dr.-Engr. E.H. Ludwig Boelkow

1987 p 225-234 In GERMAN Presented at the BMFT-Status-Seminar, Munich, Fed. Republic of Germany, Apr. 1986 (For primary document see N88-17819 10-31)
(MBB-UD-472/86) Copyright Avail: NTIS HC A14/MF A01

N88-17863# Messerschmitt-Boelkow-Blohm G.m.b.H., Ottobrunn (West Germany). Unternehmensgruppe Wehrtechnik.
AERODYNAMIC ASPECTS OF THE CONFIGURATIONAL SYSTEMS LAYOUT OF A DISPENSER [AERODYNAMISCHE GESICHTSPUNKTE DER KONFIGURATIVEN SYSTEMAUSLEGUNG EINES DISPENSERS]
Horst Schneider *In its* Research and Development. Technical-Scientific Publications (1956-1987): Retrospective View and Prospects. Jubilee Edition on the Occasion of the 75th Anniversary of Dipl.-Engr. Dr.-Engr. E.H. Ludwig Boelkow 1987 p 289-292 In GERMAN (For primary document see N88-17819 10-31)
(MBB-UA-1047/87) Copyright Avail: NTIS HC A14/MF A01

06 AIRCRAFT INSTRUMENTATION

Includes cockpit and cabin display devices; and flight instruments.

For related information see also *19 Spacecraft Instrumentation* and *35 Instrumentation and Photography.*

No abstracts in this category.

07 AIRCRAFT PROPULSION AND POWER

Includes prime propulsion systems and systems components, e.g., gas turbine engines and compressors; and onboard auxilliary power plants for aircraft.

For related information see also *20 Spacecraft Propulsion and Power, 28 Propellants and Fuels,* and *44 Energy Production and Conversion.*

N88-17647# Advisory Group for Aerospace Research and Development, Neuilly-Sur-Seine (France). Propulsion and Energetics Panel.
ADVANCED TECHNOLOGY FOR AERO GAS TURBINE COMPONENTS
Sep. 1987 541 p In ENGLISH and FRENCH Symposium held in Paris, France, 4-8 May 1987
(AGARD-CP-421; ISBN-92-835-0433-X) Copyright Avail: NTIS HC A23/MF A01

The Symposium is aimed at highlighting the development of advanced components for new aero gas turbine propulsion systems in order to provide engineers and scientists with a forum to discuss recent progress in these technologies and to identify requirements for future research. Axial flow compressors, the operation of gas turbine engines in dust laden atmospheres, turbine engine design, blade cooling, unsteady gas flow through the stator and rotor of a turbomachine, gear systems for advanced turboprops, transonic blade design and the development of a plenum chamber burner system for an advanced VTOL engine are among the topics discussed. For individual titles, see N88-17648 through N88-17681.

N88-17648# Air Force Wright Aeronautical Labs., Wright-Patterson AFB, Ohio. Turbine Engine Div.
THE COMING REVOLUTION IN TURBINE ENGINE TECHNOLOGY
James S. Petty and Robert E. Henderson *In* AGARD Advanced Technology for Aero Gas Turbine Components Sep. 1987 10 p (For primary document see N88-17647 10-07)
Copyright Avail: NTIS HC A23/MF A01

A major change in turbopropulsion technology development philosophy is now being pursued by the U.S. Air Force Wright Aeronautical Laboratories (AFWAL) which will provide revolutionary advancements in overall operational performance capability for future military aircraft and aerospace weapon systems. An historical perspective illustrates the significance of the advancements being pursued, with engine thrust-to-weight used as the principal performance figure-of-merit. The High Performance Turbine Engine Technologies (HPTET) effort, begun in 1982, is discussed. The overall goal of the effort is to provide the advanced materials, innovative structural concepts and advanced aerothermodynamics to double turbopropulsion capability by the year 2000. Author

N88-17649# Rolls-Royce Ltd., Bristol (England). Lift Engines and Future Technology Demonstrators.
OPTIMISATION OF MILITARY COMPRESSORS FOR WEIGHT AND VOLUME
K. R. Garwood *In* AGARD Advanced Technology for Aero Gas Turbine Components Sep. 1987 7 p Sponsored by Procurement Executive Ministry of Defence, United Kingdom (For primary document see N88-17647 10-07)
Copyright Avail: NTIS HC A23/MF A01

The high pressure compression system for future fighter engines has been projected at two different proven technology standards. For a given cycle of approximately 175 lbs. and 25:1 overall pressure ratio, three compressors have been evaluated, ranging from a seven stage unit with medium loading, to a five and a four stage unit with high loading. Test data of the original research parent compressors and two project specific units was commonised to the engine size and conditions. It is shown that apparent benefits between machines are negated and no significant advantage for lower work per stage could be identified at a given blading technology standard. Relative to the seven stage unit, a weight advantage of 20 percent is gained by the adoption of a four stage unit, and it is associated with an airfoil count reduction of 15 percent. Author

N88-17650# Royal Aircraft Establishment, Farnborough (England).
AN EXAMINATION OF THE IMPACT OF POTENTIAL ADVANCES IN COMPONENT TECHNOLOGY FOR FUTURE MILITARY ENGINES
M. R. Litchfield and M. G. Philpot *In* AGARD Advanced Technology for Aero Gas Turbine Components Sep. 1987 13 p (For primary document see N88-17647 10-07)
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The prospects for major advances in gas turbine engine component technology over the next 20 years are examined. For future military engines and aircraft, these advances could lead to considerably higher thrust/weight ratios than are currently available. The gains in engine performance resulting from various specific technology advances are outlined and their impact on sizing and performance of a typical combat aircraft are considered. In conjunction with these future projections, an examination is also made of the influences of the main engine cycle parameters such as overall pressure ratio, bypass ratio, and rating philosophy on the mass and performance of the aircraft/engine combination. Author

N88-17651# Societe Nationale d'Etudes et de Construction de Moteurs d'Aviation, Moissy-Cramayel (France).
SPECIFICATION OF AN ENGINE AND ITS COMPONENTS STARTING FROM A CONSIDERATION OF AIRCRAFT MISSIONS [SPECIFICATION DU MOTEUR ET DE SES COMPOSANTS A PARTIR DES MISSIONS DE L'AVION]
A. Lardellier and J. Dufau *In* AGARD Advanced Technology for Aero Gas Turbine Components Sep. 1987 13 p In FRENCH (For primary document see N88-17647 10-07)
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A computer implemented methodology for the optimization of engine cycles is described. The integrated technique considers engine size and mechanical design features, basic aircraft aerodynamic and weight/size characteristics, and aircraft mission

operational requirements. Three applications of the method are discussed: the influence of engine weight on the aircraft and mission characteristics; the influence of afterburn on supersonic cruise missions; and the influence of mission parameters on engine cycle and aircraft size. Author

N88-17652# Technische Hochschule, Aachen (West Germany). Inst. fuer Strahlantriebe und Turboarbeitsmaschinen.

APPLICATION OF HIGHLY LOADED SINGLE-STAGE MIXED-FLOW COMPRESSORS IN SMALL JET-ENGINES

R. Moenig, K. D. Broichhausen (Motoren- und Turbinen-Union Muenchen G.m.b.H., West Germany), and H. E. Gallus *In* AGARD Advanced Technology for Aero Gas Turbine Components Sep. 1987 11 p Sponsored by Bundesamt fuer Wehrtechnik und Beschaffung, Fed. Republic of Germany (For primary document see N88-17647 10-07)

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The predominant requirements on small jet engines are high power-to-weight ratio and low specific fuel consumption in combination with structural simplicity. The consequent demands on the compressor can be fulfilled either by a conventional two-stage unit or by an extremely loaded single stage. This single stage compressor has to be able to perform at a sufficiently large massflow and total pressure ratio. Consequently, the application of a mixed flow compressor with supersonic flow at rotor- or stator-inlet (supersonic mixed-flow compressor) turns out to be advantageous. The conception of a jet engine with a supersonic combustor demonstrates the significantly reduced size compared with other engines of the same thrust class. Author

N88-17653# Societe Turbomeca, Bordes (France).

THE ADVANTAGE OF VARIABLE GEOMETRY FOR TURBINE ENGINES AT LOW POWER [INTERET DE LA GEOMETRIE VARIABLE POUR LES TURBOMOTEURS DE FAIBLE PUISSANCE]

H. Vignau, R. Rodellar, and J. Silet *In* AGARD Advanced Technology for Aero Gas Turbine Components Sep. 1987 10 p In FRENCH (For primary document see N88-17647 10-07)

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To reduce the specific fuel consumption of gas turbines at low power, various cycles of free and bound turbine engines were studied. A variable output engine permits a significant reduction of specific consumption at partial capacity. The variation in power is obtained through the change in the variable geometry component output; engine operating pressure, turbine intake temperature, and rotation velocity constants. The models which take variable geometry systems into account should be improved to specify the potential gains of such techniques. The results of a study on a centrifugal compressor with a compression rate of 8.5 and with a variable-setting radial diffuser show that an output variation of 50 percent can be obtained with a slight variation in efficiency and low sensitivity. Author

N88-17654# Calspan Advanced Technology Center, Buffalo, N.Y.

OPERATION OF GAS TURBINE ENGINES IN DUST-LADEN ENVIRONMENTS

M. G. Dunn, C. Padova, and R. M. Adams (Defense Nuclear Agency, Washington, D.C.) *In* AGARD Advanced Technology for Aero Gas Turbine Components Sep. 1987 16 p (For primary document see N88-17647 10-07)

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Results are reported for a measurement program designed to investigate the performance deterioration of gas turbine engines and the associated auxiliary equipment difficulties when operating in dust laden environments. Three TF33 turbofan engines and one J57 turbojet engine have been tested with two different dust blends. The predominant damage mechanism in all the engines was compressor blade erosion. The length of dust exposure time required to cause engine damage was dependent upon power setting and dust concentration. The turbine inlet temperature for these engines was too low to realize deposition of glassy material on the hot section components. The Environmental Control System (ECS) was monitored to ascertain the amount of injested material and the size distribution of material that makes its way to the ECS. A significant fraction of the dust is not centrifuged out of the flow and does end up in the control system air. These particles have a mean size on the order of 6 microns. The engine parameters most indicative of degradation were identified and are discussed. Author

N88-17655# National Research Council of Canada, Ottawa (Ontario). Gas Dynamics Lab.

A RESEARCH PROGRAM ON THE AERODYNAMICS OF A HIGHLY LOADED TURBINE STAGE

R. G. Williamson, S. H. Moustapha, J. P. Huot, and U. Okapuu (Pratt and Whitney Aircraft of Canada Ltd., Longueuil, Quebec) *In* AGARD Advanced Technology for Aero Gas Turbine Components Sep. 1987 17 p (For primary document see N88-17647 10-07)

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The main conclusions drawn from recent work in an on-going experimental program of research on the aerodynamics of a highly loaded turbine stage are discussed. Detailed data have been secured relating to the aerodynamic performance of transonic nozzles of high turning angle (tested with two outer wall contours) and the influence of the stage environment on such measurements. Further work addresses rotor performance (as affected by blade loading), and also overall stage performance. The ultimate objective of the work is the extension of turbine design methods to regimes combining high stage loadings with high pressure ratios, with special emphasis on small blade sizes. Author

N88-17656*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.

EXPERIMENTAL EVALUATION OF A TRANSLATING NOZZLE SIDEWALL RADIAL TURBINE

Richard J. Roelke and Casimir Rogo (Teledyne CAE, Toledo, Ohio.) *In* AGARD Advanced Technology for Aero Gas Turbine Components Sep. 1987 13 p (For primary document see N88-17647 10-07)

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An experimental performance evaluation was made of two movable sidewall variable area radial turbines. The turbine designs were representative of the gas generator turbine of a variable flow capacity rotorcraft engine. The first turbine was an uncooled design while the second turbine had a cooled nozzle but an uncooled rotor. The cooled nozzle turbine was evaluated both with and without coolant flow. The test results showed that the movable nozzle wall is a viable and efficient means to effectively control the flow capacity of a radial turbine. Peak efficiencies of the second turbine with and without nozzle coolant were 86.5 and 88 percent respectively. These values are comparable to pivoting vane variable geometry turbines; however, the decrease in efficiency as the flow was varied from the design value was much less for the movable wall turbine. Several design improvements which should increase the turbine efficiency one or two more points are identified. These design improvements include reduced leakage losses and relocation of the vane coolant ejection holes to reduce mainstream disturbance. Author

N88-17657# Motoren- und Turbinen-Union Muenchen G.m.b.H. (West Germany).

AN INTEGRATED AERO/MECHANICAL PERFORMANCE APPROACH TO HIGH TECHNOLOGY TURBINE DESIGN

J. Hourmouziadis and G. Albrecht *In* AGARD Advanced Technology for Aero Gas Turbine Components Sep. 1987 12 p Sponsored by German Ministry for Research and Technology, Fed. Republic of Germany (For primary document see N88-17647 10-07)

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Analytical and experimental experience from an advanced technology gas generator program is used to define the requirements on the engineering sciences involved in the design

of gas turbine engines. Some aerodynamic, performance and cooling problems to be solved in a common approach with mechanical design for radial clearance control, hot gas path sealing and life are discussed. Author

N88-17658# Royal Aircraft Establishment, Farnborough (England).
DESIGN AND TEST OF A HIGH BLADE SPEED, HIGH WORK CAPACITY TRANSONIC TURBINE
R. C. Kingcombe, J. D. Bryce, and N. P. Leversuch *In* AGARD Advanced Technology for Aero Gas Turbine Components Sep. 1987 17 p (For primary document see N88-17647 10-07)
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A high rim-speed turbine was designed and tested. A major objective in the design was to achieve high aerodynamic efficiency at high work capacity by way of reduced stage loading facilitated by high blade speed. The design includes three dimensional features such as a parabolic distribution of exit angle and compound trailing edge lean on the nozzle guide vane and a thick root, highly tapered rotor blade - necessary in an engine turbine to reduce blade stress. Author

N88-17659# Rolls-Royce Ltd., Bristol (England). Advanced Turbine Technology Dept.
ADVANCED TECHNIQUES EMPLOYED IN BLADE COOLING RESEARCH
H. E. Rogers, C. Graham, and K. McNicholas *In* AGARD Advanced Technology for Aero Gas Turbine Components Sep. 1987 13 p Sponsored by Procurement Executive Ministry of Defence, United Kingdom (For primary document see N88-17647 10-07)
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The design of an advance cooling system for moderately cooled second stage gas turbine engine blades was undertaken as part of a demonstration project. The design process involving complex computer modeling and hot rig testing of the blades is described. The test results confirmed that substantial increases in cooling efficiency can be gained by introducing small scale turbulators into radial hole cooling systems. A development temperature measurement technique based on a video camera operating in the near infrared region is described. The results of video pyrometry were validated from results obtained from a series of demonstrator hot rig tests. Also discussed are a number of problems relating to surface temperature measurement. Author

N88-17660# Stuttgart Univ. (West Germany). Inst. fuer Aerodynamik und Gasdynamik.
THE UNSTEADY GAS FLOW THROUGH STATOR AND ROTOR OF A TURBOMACHINE
K. M. Foerster *In* AGARD Advanced Technology for Aero Gas Turbine Components Sep. 1987 10 p (For primary document see N88-17647 10-07)
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The difficulties of computing unsteady transonic flow in multiple connected domains with a minimum of neglections and approximations have been overcome by using individual computational grids fixed to each cascade, a novel gridless finite difference scheme, and physically real inflow and outflow boundaries. The resulting computer program is capable of computing the inviscid, plane gas flow through the stator and rotor of a turbomachine stage made from arbitrarily shaped (thick, round nosed) blades of arbitrary spacing, up to local Mach numbers of 1.8. Author

N88-17661# Office National d'Etudes et de Recherches Aerospatiales, Paris (France).
DESIGN AND TESTING OF A SMALL RADIAL TURBINE FOR AUXILIARY POWER UNITS [ETUDE ET ESSAIS D'UNE PETITE TURBINE RADIALE POUR GROUPES AUXILIAIRES DE PUISSANCE]
Y. Ribaud, C. Fradin, and C. Mischel (Microturbo, Toulouse, France) *In* AGARD Advanced Technology for Aero Gas Turbine Components Sep. 1987 13 p In FRENCH Sponsored in part by Ministere de la Defense, France (For primary document see N88-17647 10-07)
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A project for the development of a small centripetal turbine with an expansion ratio of 3.6 is being undertaken by the Societe MICROTURBO with computational and test analysis support from ONERA. The design goals and strengths are outlined. Preliminary calculations for the design of the nozzle and wheel blades are discussed along with quasi-three dimensional calculations. Results from cold bench tests and corresponding hot engine tests were used to evaluate performance. Presizing and flow field calculations were confirmed in view of the high values of isentropic output obtained. The flow measurements downstream from the wheel, at a nominal operating point, gave the best picture of the fluid characteristics. Author

N88-17662# Pratt and Whitney Aircraft of Canada Ltd., Longueuil (Quebec). Turbine Aerodynamics.
DESIGN AND AERODYNAMIC PERFORMANCE OF A SMALL MIXED-FLOW GAS GENERATOR TURBINE
U. Okapuu *In* AGARD Advanced Technology for Aero Gas Turbine Components Sep. 1987 11 p (For primary document see N88-17647 10-07)
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Design details and results from aerodynamic rig tests are presented for four variants of a mixed flow turbine having a design target pressure ratio of 3:1. This experimental turbine, designed to satisfy the aerodynamic requirements of a gas generator turbine in a hypothetical small turboprop engine, demonstrated a design point efficiency substantially in excess of that predicted for a single stage axial turbine of equivalent duty. Design and material implications are discussed and potential constraints identified. Author

N88-17663# Ecole Centrale de Lyon (France).
NUMERICAL SIMULATION OF DIFFUSER/COMBUSTOR DOME INTERACTION [SIMULATION NUMERIQUE DE L'INTERACTION DIFFUSEUR TETE DE CHAMBRE]
D. Jeandel, G. Brun, S. Meunier, and M. Desaulty (Societe Nationale d'Etudes et de Construction de Moteurs d'Aviation, Moissy-Cramayel, France) *In* AGARD Advanced Technology for Aero Gas Turbine Components Sep. 1987 10 p In FRENCH (For primary document see N88-17647 10-07)
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The design of a turbojet diffuser and combustion chamber dome can be realized, not only by researching low pressure loss, but also by assuring flow stability around a flame tube. A finite element method developed by Ecole Centrale de Lyon is described. The method employs an elliptic logic and a triangular type mesh which is well adapted for simulating complex geometric configurations. The application of the algorithm to various elementary and industrial configurations demonstrates the method's robustness and its ability to describe the principal flow characteristics in combustion dome regions. Author

N88-17664# Rolls-Royce Ltd., Bristol (England).
DEVELOPMENT OF A PLENUM CHAMBER BURNER SYSTEM FOR AN ADVANCED VTOL ENGINE
J. S. Lewis, T. W. Murray, and D. Steele *In* AGARD Advanced Technology for Aero Gas Turbine Component Sep. 1987 10 p Sponsored by Procurement Executive Ministry of Defence, United Kingdom (For primary document see N88-17647 10-07)
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The research and development programs that were carried out on model and full size rigs to design and evaluate advanced concepts to meet the anticipated thrust requirements for a plenum chamber burner system for an advanced vertical takeoff and landing (VTOL) aircraft are described. The system characteristics of pressure loss, ignition, efficiency, thermal integrity and velocity profiles at nozzle exit under non-combusting (dry) and combusting conditions are discussed. Author

N88-17665# Lucas Aerospace Ltd., Birmingham (England). Engine Systems Div.

PUMPING SYSTEMS AND FLOW INTERFACES FOR RAPID RESPONSE ELECTRONIC REHEAT CONTROLS

Thomas C. Yates and Trevor S. Smith *In* AGARD Advanced Technology for Aero Gas Turbine Components Sep. 1987 20 p Sponsored by Procurement Executive Ministry of Defence, United Kingdom (For primary document see N88-17647 10-07)

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The problems of fuel pumping and metering which are associated with digital electronic reheat controls are discussed. A survey is carried out of various pumping options including reheat and main engine fuel pumping. A technical description of single, twin, and three pump systems, including rotodynamic and positive displacement pumps is given together with comments on the relative advantages and disadvantages of the various options. A fuel flow interface designed for rapid response reheat control systems is described. The application is a digital electronic control for a future bypass engine. Comparison is made between computer simulation of the control characteristics and test results of the hardware. Author

N88-17666*# General Electric Co., Cincinnati, Ohio. Aircraft Engine Business Group.

AERODYNAMIC PERFORMANCE OF A SCALE-MODEL, COUNTER-ROTATING UNDUCTED FAN

Thomas J. Sullivan *In* AGARD Advanced Technology for Aero Gas Turbine Components Sep. 1987 16 p Sponsored by NASA, Washington, D.C. (For primary document see N88-17647 10-07)

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The aerodynamic performance of a scale model, counter-rotating unducted fan has been determined and the results are discussed. Experimental investigations were conducted using the scale model propulsor simulator and uniquely shaped fan blades. The blades, designed for a high disk loading at Mach 0.72 at 35,000 feet altitude maximum climb condition are aft-mounted on the simulator in a pusher configuration. Data are compared with analytical predictions at the design point and show good agreement. Author

N88-17667*# General Motors Corp., Indianapolis, Ind. Gas Turbine Div.

GEAR SYSTEMS FOR ADVANCED TURBOPROPS

Douglas A. Wagner *In* AGARD Advanced Technology for Aero Gas Turbine Components Sep. 1987 9 p Sponsored by NASA, Washington, D.C. (For primary document see N88-17647 10-07)

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A new generation of transport aircraft will be powered by efficient, advanced turboprop propulsion systems. Systems that develop 5,000 to 15,000 horsepower have been studied. Reduction gearing for these advanced propulsion systems is discussed. Allison Gas Turbine Division's experience with the 5,000 horsepower reduction gearing for the T56 engine is reviewed and the impact of that experience on advanced gear systems is considered. The reliability needs for component design and development are also considered. Allison's experience and their research serve as a basis on which to characterize future gear systems that emphasize low cost and high reliability. Author

N88-17668# Deutsche Forschungs- und Versuchsanstalt fuer Luft- und Raumfahrt, Brunswick (West Germany). Inst. fuer Entwurfsaerodynamik.

NUMERICAL METHODS FOR PROPELLER AERODYNAMICS AND ACOUSTICS AT DFVLR

N. Kroll, D. Lohmann, and J. Schoene *In* AGARD Advanced Technology for Aero Gas Turbine Components Sep. 1987 15 p (For primary document see N88-17647 10-07)

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Linear and nonlinear analysis methods for flow fields around propellers were developed. Here, two singularity methods are presented. In the first, a doublet point scheme was formulated for the calculation of steady and unsteady loads on surfaces having helical motion in an incompressible medium, e.g., propellers in uniform and nonuniform inflows and counter rotating propellers. The second is a surface panel method for computations of steady subsonic flows around propeller blades moving in a compressible medium. The method has been extended for the prediction of acoustic quantities. In order to predict the characteristics of transonic propeller flow fields, a Euler code for solving the three dimensional Euler equations was extended. The equations are formulated in a rotating cartesian reference frame. The solution procedure is based on a finite volume method using an explicit Runge-Kutta time stepping scheme. Numerical results for various propeller geometries are presented and compared with experimental data. Author

N88-17669# Office National d'Etudes et de Recherches Aerospatiales, Paris (France).

ANALYSIS OF HIGHSPEED PROPELLERS AERODYNAMICS

J. M. Bousquet *In* AGARD Advanced Technology for Aero Gas Turbine Components Sep. 1987 12 p In FRENCH; ENGLISH summary (For primary document see N88-17647 10-07)

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Highspeed propellers are studied. A synthesis of aerodynamic developments leading to the HT3 propeller definition and test in the S1 Modane wind tunnel is presented. The validity of the main calculation methods used in this research is analyzed. Counterrotating highspeed propellers are also studied. Their performance benefits against single rotation propellers are presented. Author

N88-17670# Fiat Aviazione S.p.A., Turin (Italy). Direzione Progettazione.

ANALYSIS OF POSSIBLE TRANSMISSION ARRANGEMENTS APPLICABLE FOR DRIVING SINGLE OR TWIN COUNTERROTATING FANS ON PROPFAN ENGINES

L. Battezzato and S. Turra *In* AGARD Advanced Technology for Aero Gas Turbine Components Sep. 1987 11 p (For primary document see N88-17647 10-07)

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A number of different designs of propfan engines are now being defined by the main engine manufacturers in the world. Some of these designs require a reduction gearbox between the LP turbine and the propfan; the propfan itself is conceived as single stage, variable pitch blade or double counterrotating stage variable pitch solution. In order to satisfy these requirements, the authors propose different mechanical arrangements of the reduction gearbox and, for given engine interfaces, compare their relative merits in order to eventually show the optimum solution. The comparison is made on the basis of various aspects: lightness, quietness, life, reliability, safety and maintainability. Author

N88-17671# Stuttgart Univ. (West Germany). Inst. fuer Aero- und Gasdynamik.

TRANSONIC BLADE DESIGN ON ROTATIONAL STREAM SURFACES

F. Klimetzek and E. Schmidt *In* AGARD Advanced Technology for Aero Gas Turbine Components Sep. 1987 11 p (For primary document see N88-17647 10-07)

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A method enabling the computation of cascade profiles from prescribed velocity distributions in a relative system is presented. The optimization of the velocity distributions in a relative system is presented. The optimization of the velocity distribution to attain definite values in parameters such as turning angle, chord length or profile thickness is also included. Comparisons between the inverse design method with various analysis programs for cascades in both absolute and relative systems show good agreement. Author

N88-17672# Von Karman Inst. for Fluid Dynamics, Rhode-Saint-Genese (Belgium).

INVESTIGATION OF DIHEDRAL EFFECTS IN COMPRESSOR CASCADES

F. A. E. Breugelmans *In* AGARD Advanced Technology for Aero Gas Turbine Components Sep. 1987 14 p (For primary document see N88-17647 10-07)
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An experimental investigation of the influence of blade dihedral on the secondary flow in the two dimensional NACA 65-series compressor cascade is performed. Different inlet boundary layer thicknesses are used on the endwalls. Three different stacking lines have been chosen, namely a straight line inclined at 15, 25 and 35 degrees, a circular arc and an elliptic arc. The incidence range up to stall has been investigated and the local and overall losses are compared. The obtuse angle between the blade suction surface and the endwall has a beneficial effect on overall and secondary flow loss. Some limitations have to be accepted, depending on boundary layer thickness and incidence. Author

N88-17673# Ecole Centrale de Lyon (France). Lab. de Mecanique des Fluides.
PARAMETRIC STUDY OF CHOKE FLUTTER WITH A LINEAR THEORY
Pascal Ferrand *In* AGARD Advanced Technology for Aero Gas Turbine Components Sep. 1987 14 p In FRENCH; ENGLISH summary Sponsored by Societe Nationale d'Etude et de Construction de Moteurs d'Aviation, France (For primary document see N88-17647 10-07)
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When the choke flutter problem arises in the stator, the incidence is slightly negative and the inlet Mach number is subsonic. A one dimensional unsteady approach is used in the blade channel and out of the cascade. The equations describe the unsteady two dimensional periodical flow field. The results are compared to experimental data from tests. A parametric study was developed to understand the influence of stationary velocity gradient and shock wave movement. The results obtained do not contradict each other, but they lead to different explanations. For instance, the shock wave movement was found to depend highly upon upstream perturbations, but weakly upon downstream flow. For the first time, these results point toward possibilities for limiting the choke flutter domain. Author

N88-17674# Technische Univ., Hanover (West Germany). Inst. fuer Stroemungsmaschinen.
POSSIBILITIES FOR ON-LINE SURGE SUPPRESSION BY FAST GUIDE VANE ADJUSTMENT IN AXIAL COMPRESSORS
W. Riess and U. Bloecker *In* AGARD Advanced Technology for Aero Gas Turbine Components Sep. 1987 15 p (For primary document see N88-17647 10-07)
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The usual surge suppression regulation is realized by integration of a fixed limit line into the regulation system at a safe distance from the stability limit of the compressor. With appropriate means for detection of stall and surge in addition to fast response of the guide vane adjustment, an adaptive system for surge suppression which takes into account the actual state of the compressor could be realized. Experimental results for stall detection and for different modes of guide vane adjustment are presented. A six stage axial compressor is equipped with fast acting guide vane adjustment in all stages. Author

N88-17675# Norges Tekniske Hoegskole, Trondheim. Div. of Hydro- and Gas Dynamics.
RADIAL COMPRESSOR DESIGN USING AN EULER SOLVER
Jan Tore Billdal and Andrew Wilson *In* AGARD Advanced Technology for Aero Gas Turbine Components Sep. 1987 12 p (For primary document see N88-17647 10-07)
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The steady inviscid flow through a radial compressor is computed by solving the three dimensional Euler equations on both an H-type and O-type grid. The centered finite volume method with an explicit integration scheme is used to solve the equations. The numerical programs were developed as a tool in the design process of new, high pressure radial compressors with complex geometries and spitterblades. Author

N88-17676# Deutsche Forschungs- und Versuchsanstalt fuer Luft- und Raumfahrt, Cologne (West Germany). Inst. fuer Antriebstechnik.
SECONDARY FLOW MEASUREMENTS WITH L2F-TECHNIQUE IN CENTRIFUGAL COMPRESSORS
H. Krain *In* AGARD Advanced Technology for Aero Gas Turbine Components Sep. 1987 10 p (For primary document see N88-17647 10-07)
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The flow characteristics of a 30 degree backswept impeller are analyzed by means of the L2F measurement technique. Significant cross flows, noticeable distortions of the through flow patterns and considerable velocity fluctuations were found inside the blade passages of the impeller. The distortions of the velocity patterns are smoothing towards the impeller exit. A detailed analysis of the measured data reveals the existence of two counter rotating channel vortices that are significantly influencing the overall flow character. Author

N88-17677# Centre National de la Recherche Scientifique, Marseilles (France).
METHOD FOR PREDICTING PERFORMANCE LIMITS OF CENTRIFUGAL COMPRESSORS [METHODE DE PREVISION DES LIMITES DE FONCTIONNEMENT EN DEBIT DES COMPRESSEURS CENTRIFUGES]
H. Miton, G. Senatore, and J. Chauvin (LEMFI, Orsay, France) *In* AGARD Advanced Technology for Aero Gas Turbine Components Sep. 1987 12 p In FRENCH (For primary document see N88-17647 10-07)
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Currently, the phenomena which impose performance limits in centrifugal compressors are not clearly identifiable. If pumping and rotating stall are frequently observed at partial output, it is not certain whether the pumping limit is imposed by purely nonstationary phenomena. The approach described here consists of determining that limit by specifically applying the load criteria in the axial region of the moving impeller and the diffuser semi-blade section. The performance limit is assumed to be reached when impeller and diffuser are simultaneously stalled. The results of a simple analysis method, applied to two compressors having very different geometric characteristics, show a fairly good agreement between the performance limit defined with this criterion and the experimental pumping limit. M.G.

N88-17678# Pratt and Whitney Aircraft, West Palm Beach, Fla. Engineering Div.
DESIGN AND DEVELOPMENT OF AN ADVANCED F100 COMPRESSOR
Charles M. Love *In* AGARD Advanced Technology for Aero Gas Turbine Components Sep. 1987 12 p (For primary document see N88-17647 10-07)
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The aerodynamic and mechanical design features of an advanced F100 compressor are described. The design objectives were to increase the efficiency and stability, along with simplifying the mechanical configuration in order to reduce the number of parts. Test results from a compressor rig and core engine are shown. Comparisons of the performance to the current F100 compressor are made. Results of testing with inlet pressure distortion are shown. Configuration features to improve reliability, durability, maintainability and producibility are shown. Author

N88-17679# Societe Nationale d'Etudes et de Construction de Moteurs d'Aviation, Moissy-Cramayel (France).
DESIGN AND TESTING OF A FRONT STAGE FOR AN ADVANCED HIGH PRESSURE COMPRESSOR [CONCEPTION ET ESSAIS D'UN ETAGE DE TETE D'UN COMPRESSEUR HP AVANCE]
Marius Goutines and Henri Naviere *In* AGARD Advanced Technology for Aero Gas Turbine Components Sep. 1987 15 p In FRENCH Sponsored by Direction des Recherches, Etudes et Techniques du Ministere de la Defense, France (For

primary document see N88-17647 10-07)
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Studies of an advanced high pressure compressor show that the front stage rotor is supersonic all along the span of the blades. SNECMA designed and constructed a monostage compressor to evaluate performances, especially secondary flows. The approach used in the compressor project, the design configuration, and velocity triangles selected for nominal operation level are described. The supersonic profiles were optimized by the direct solution of the three dimensional Euler equations. The subsonic profiles were optimized by a direct potential method coupled with a boundary layer calculation. The global performances are addressed. The measured aerodynamic fields and azimuthal means are compared to the theoretical predictions for the front wall secondary flow region. Author

N88-17680# Deutsche Forschungs- und Versuchsanstalt fuer Luft- und Raumfahrt, Cologne (West Germany). Inst. fuer Antriebstechnik.
EXPERIMENTAL INVESTIGATION OF A SUPERCRITICAL COMPRESSOR ROTOR BLADE SECTION
R. Fuchs, R. Kaymaz, H. Starken, and W. Steinert *In* AGARD Advanced Technology for Aero Gas Turbine Components Sep. 1987 11 p (For primary document see N88-17647 10-07)
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A controlled diffusion rotor blade section was designed for a supercritical inlet Mach number of M sub 1 equals 0.85 and a flow turning of 29 degrees. The blade section has been tested in a cascade wind tunnel under various inlet flow conditions and axial velocity density ratios. A detailed investigation about transition and separation points was carried out at the design and at two off-design inlet flow conditions. The results are presented and discussed. Author

N88-17681# Societe Nationale d'Etudes et de Construction de Moteurs d'Aviation, Moissy-Cramayel (France).
COMPUTATION OF SECONDARY FLOWS IN AN AXIAL MULTISTAGE COMPRESSOR [CALCUL DES ECOULEMENTS SECONDAIRES DANS UN COMPRESSEUR AXIAL MULTIETAGE]
F. Falchetti and J. Brochet *In* AGARD Advanced Technology for Aero Gas Turbine Components Sep. 1987 13 p In FRENCH; ENGLISH summary Sponsored by Direction des Recherches, Etudes et Techniques, France and Societe National d'Etude et de Construction de Moteurs d'Aviation, France (For primary document see N88-17647 10-07)
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SNECMA has developed and extended the use of a secondary flow computation method for axial flow compressors. This method takes into account the secondary phenomena through a viscous correction applied to a through flow calculation. This correction is calculated to the complete meridan plane, including the bladerows. A set of equations deduced from three dimensional parabolized and pitchwise averaged Navier-Stokes equations are solved. A classical coupling process between the secondary flow and the through flow computations is insured through mass flow injection. After reviewing the main features of the method, an application to a multistage compressor is presented. The application of this method to the design of end-bend blades is shown. Author

08 AIRCRAFT STABILITY AND CONTROL

Includes aircraft handling qualities; piloting; flight controls; and autopilots.

For related information see also *05 Aircraft Design, Testing and Performance.*

N88-17682# Advisory Group for Aerospace Research and Development, Neuilly-Sur-Seine (France).
EFFECTIVENESS OF VARIOUS CONTROL SURFACES IN QUASI-STEADY AND UNSTEADY CONDITIONS [EFFICACITE DE DIFFERENTES SURFACES DE CONTROLE EN QUASI-STATIONNAIRE ET INSTATIONNAIRE]
R. Destuyner, R. Barreau, and G. Anders Apr. 1986 26 p In FRENCH Presented at the 6th Meeting of the AGARD Panel on Structures and Materials, Oberammergau, Fed. Republic of Germany, 8-13 Sept. 1985
(AGARD-R-735; ISBN-92-835-2113-7) Copyright Avail: NTIS HC A03/MF A01

This report describes tests conducted in the Modane S1 wind tunnel in France to measure the unsteady pressures on two half-models of wings outfitted with different control surfaces such as vented or unvented spoilers, flaperons, or ailerons. One of the wings, the ZKP model, is a standard configuration from the AGARD-SMP Compendium of Unsteady Pressure Measurements. The movements imposed on the control surfaces could be white noise, fixed frequency harmonics and ramp. A data base with a very wide range of parameters such as the Mach number, wing angle of attack, deflection of one or several control surfaces, and reduced frequencies was obtained. One of the goals was to establish semiempirical corrections to the theory of the efficiency of control surfaces. All of the excitation tests and acquisition and processing work for the unsteady condition studies were completely directed by a computer. Author

N88-17683 Virginia Polytechnic Inst. and State Univ., Blacksburg.
SENSITIVITY OF ACTIVE VIBRATION CONTROL TO STRUCTURAL CHANGES AND MODEL REDUCTION Ph.D. Thesis
Zoran Naum Martinovic 1987 123 p
Avail: Univ. Microfilms Order No. DA8721990

The analytical study presented is concerned with two types of sensitivity of active vibration control of large space structures (LSS). The first one required for assessing robustness, is the sensitivity of the performance and stability of the control system to changes in structure and to model reduction. The second type is the sensitivity of the optimum design of the control system to changes in the structure. This sensitivity is of interest in assessing the need for integrated structure/control design. Three direct rate feedback control techniques are studied for a laboratory structure which has characteristics of LSS and then compared to standard linear quadratic control. The baseline design of each control system is obtained first and then sensitivity analysis conducted. Dissert. Abstr.

N88-17684*# National Aeronautics and Space Administration. Langley Research Center, Hampton, Va.
AN APPLICATION OF EIGENSPACE METHODS TO SYMMETRIC FLUTTER SUPPRESSION Final Report
Robert E. Fennell (Clemson Univ., S.C.) Jan. 1988 22 p Submitted for publication
(Contract NAS1-18107; Grant N00014-86-K-0693)
(NASA-CR-181618; ICASE-88-9; NAS 1.26:181618) Avail: NTIS HC A03/MF A01 CSCL 01C

An eigenspace assignment approach to the design of parameter insensitive control laws for linear multivariable systems is presented. The control design scheme utilizes flexibility in eigenvector assignments to reduce control system sensitivity to changes in system parameters. The methods involve use of the singular value decomposition to provide an exact description of allowable eigenvectors in terms of a minimum number of design parameters.

In a design example, the methods are applied to the problem of symmetric flutter suppression in an aeroelastic vehicle. In this example the flutter mode is sensitive to changes in dynamic pressure and eigenspace methods are used to enhance the performance of a stabilizing minimum energy/linear quadratic regulator controller and associated observer. Results indicate that the methods provide feedback control laws that make stability of the nominal closed loop systems insensitive to changes in dynamic pressure. Author

N88-17601*# Sikorsky Aircraft, Stratford, Conn.
THE IMPACT OF CIRCULATION CONTROL ON ROTARY AIRCRAFT CONTROLS SYSTEMS
R. F. Kingloff and D. E. Cooper *In* NASA. Ames Research Center Proceedings of the Circulation-Control Workshop, 1986 May 1987 p 353-362 (For primary document see N88-17586 10-02)
Avail: NTIS HC A25/MF A01 CSCL 01C

N88-17836# Messerschmitt-Boelkow-Blohm G.m.b.H., Hamburg (West Germany). Unternehmensgruppe Transport- und Verkehrsflugzeuge.
LIGHT ELECTRONIC CONTROL SYSTEM (LECOS): A PROPOSAL FOR A INTERCONNECTED ERROR-TOLERANT, OPTOELECTRONIC CONTROL SYSTEM [LECOS - EIN VORSCHLAG FUER EIN VERMASCHTES, FEHLERTOLERANTES, LICHTELEKTRONISCHES STEUERUNGSSYSTEM]
Hans-Joachim Wendt *In its* Research and Development. Technical-Scientific Publications (1956-1987): Retrospective View and Prospects. Jubilee Edition on the Occasion of the 75th Anniversary of Dipl.-Engr. Dr.-Engr. E.H. Ludwig Boelkow 1987 p 115-118 In GERMAN (For primary document see N88-17819 10-31)
(MBB-UT-004/87) Copyright Avail: NTIS HC A14/MF A01

N88-17845# Messerschmitt-Boelkow-Blohm G.m.b.H., Ottobrunn (West Germany). Unternehmensgruppe Hubschrauber und Flugzeuge.
ACTIVE CONTROL TECHNOLOGY WITH ADAPTIVE CONTROL CONCEPT IN THE AIRCRAFT CONSTRUCTION [AKTIVE KONTROLL TECHNOLOGIE MIT ADAPTIVEM REGLERKONZEPT IM FLUGZEUGBAU]
Heinz Hoenlinger *In its* Research and Development. Technical-Scientific Publications (1956-1987): Retrospective View and Prospects. Jubilee Edition on the Occasion of the 75th Anniversary of Dipl.-Engr. Dr.-Engr. E.H. Ludwig Boelkow 1987 p 167-172 In GERMAN (For primary document see N88-17819 10-31)
(MBB/LKE-294/S/PUB/295) Copyright Avail: NTIS HC A14/MF A01

09 RESEARCH AND SUPPORT FACILITIES (AIR)

Includes airports, hangars and runways; aircraft repair and overhaul facilities; wind tunnels; shock tubes; and aircraft engine test stands.

For related information see also *14 Ground Support Systems and Facilities (Space).*

N88-17685# Government of India, New Delhi.
DIRECTOR OF R AND D INSTITUTIONS (GOVERNMENT OF INDIA)
Sep. 1987 254 p
(PB88-127162) Avail: NTIS HC A12/MF A01 CSCL 14B

The directory is divided into two parts. Part 1 containes the names and the complete addresses of the R & D institutions arranged according to: (1) central government institutions including the public sector in-house R & D units; (2) state government institutions including their public/joint sector in-house R & D units; (3) universities including institutions of national importance; and (4) private sector in-house R & D units. In Part 2, these R & D institutions are organized according to the state and union territories in which they are located. Within each state, the classifications as indicated in Part 1 is followed. There is a demand from different experts for the analyses of the distribution of R & D units in different regions of the country as it is felt that some regions are pockets of concentrations with a large number of R & D institutions located in such regions as compared to others. GRA

N88-17686*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.
EXPERIMENTAL EVALUATION OF TURNING VANE DESIGNS FOR HIGH-SPEED AND COUPLED FAN-DRIVE CORNERS OF 0.1-SCALE MODEL OF NASA LEWIS RESEARCH CENTER'S PROPOSED ALTITUDE WIND TUNNEL
Thomas F. Gelder, Royce D. Moore, Rickey J. Shyne, and Donald R. Boldman May 1987 54 p Microfiche available as supplement
(NASA-TP-2681; E-3218; NAS 1.60:2681) Avail: NTIS HC A04/MF A01 CSCL 14B

Two turning vane designs were experimentally evaluated for the fan-drive corner (corner 2) coupled to an upstream diffuser and the high-speed corner (corner 1) of the 0.1 scale model of NASA Lewis Research Center's proposed Altitude Wind Tunnel. For corner 2 both a controlled-diffusion vane design (vane A4) and a circular-arc vane design (vane B) were studied. The corner 2 total pressure loss coefficient was about 0.12 with either vane design. This was about 25 percent less loss than when corner 2 was tested alone. Although the vane A4 design has the advantage of 20 percent fewer vanes than the vane B design, its vane shape is more complex. The effects of simulated inlet flow distortion on the overall losses for corner 1 or 2 were small. Author

N88-17687# Oak Ridge Gaseous Diffusion Plant, Tenn.
ULTRA-LOW FREQUENCY VIBRATION DATA ACQUISITION CONCERNS IN OPERATING FLIGHT SIMULATORS
B. W. VanHoy 1988 20 p Presented at the 6th International Modal Analysis Conference, Orlando, Fla., 1 Feb. 1988 Prepared in cooperation with ORNL, Tenn.
(Contract DE-AC05-84OT-21400)
(DE88-004795; K/D-5739; CONF-880220-13) Avail: NTIS HC A03/MF A01

The measurement of ultra-low frequency vibration (.01 to 1.0 Hz) in motion based flight simulators was undertaken to quantify the energy and frequencies of motion present during operation. Methods of measurement, the selection of transducers, recorders, and analyzers and the development of a test plan, as well as types of analysis are discussed. Analysis of the data using a high-speed minicomputer and a comparison of the computer analysis with standard FFT analysis are also discussed. Measurement of simulator motion with the pilot included as part of the control dynamics had not been done up to this time. The data are being used to evaluate the effect of low frequency energy on the vestibular system of the air crew, and the incidence of simulator induced sickness. DOE

12 ASTRONAUTICS (GENERAL)

For extraterrestrial exploration see *91 Lunar and Planetary Exploration.*

N88-17688*# Boeing Aerospace Co., Seattle, Wash.
SPACE STATION INTEGRATED WALL DAMAGE AND PENETRATION DAMAGE CONTROL. TASK 5: SPACE DEBRIS MEASUREMENT, MAPPING AND CHARACTERIZATION SYSTEM Final Report, 1 Aug. - 16 Dec. 1987
B. M. Lempriere 16 Dec. 1987 107 p
(Contract NAS8-36426)
(NASA-CR-179281; NAS 1.26:179281; D180-30708-1) Avail: NTIS HC A06/MF A01 CSCL 22A

The procedures and results of a study of a conceptual system for measuring the debris environment on the space station is

discussed. The study was conducted in two phases: the first consisted of experiments aimed at evaluating location of impact through panel response data collected from acoustic emission sensors; the second analyzed the available statistical description of the environment to determine the probability of the measurement system producing useful data, and analyzed the results of the previous tests to evaluate the accuracy of location and the feasibility of extracting impactor characteristics from the panel response. The conclusions were that for one panel the system would not be exposed to any event, but that the entire Logistics Module would provide a modest amount of data. The use of sensors with higher sensitivity than those used in the tests could be advantageous. The impact location could be found with sufficient accuracy from panel response data. The waveforms of the response were shown to contain information on the impact characteristics, but the data set did not span a sufficient range of the variables necessary to evaluate the feasibility of extracting the information. Author

N88-17689# Messerschmitt-Boelkow-Blohm G.m.b.H., Bremen (West Germany).
STUDY ON LONG TERM EVOLUTION TOWARDS EUROPEAN MANNED SPACE FLIGHT. VOLUME 1: EXECUTIVE SUMMARY Final Report
Uwe Riedel, F. Steinsiek, H.-H. Stolte, E. Soeffker, K.-P. Ludwig, and J. Ewald, ed. Paris, France ESA Apr. 1987 100 p Prepared in cooperation with Aeritalia SpA, Turin, Italy, Battelle Inst., BAE, Stevenage, England, Dornier-Werke GmbH, Friedrichshafen, West Germany, KAMPSAX Int., Matra Espace, Toulouse, France, National Aerospace Lab., Amsterdam, Netherlands, et al
(Contract ESA-6669/86-NL-PP(SC))
(MBB-RA3-004/87-Vol-1; ESA-CR(P)-2491-Vol-1; ETN-88-91702-Vol-1) Avail: NTIS HC A05/MF A01

The feasibility of a long-term evolution based on the Columbus operational scenario and the inherent growth potential of the Columbus concept are indicated. In the medium-term (up to 2015), the evolution is driven by the goal of permanent presence of men in space, accompanied by increasing demands from scientific (and commercial) application which requires both man-supported and automated payload operation capabilities, (i.e., evolution towards minimum capability to achieve European autonomy in manned space flight). In the long-term (beyond 2015), requests for operational support capabilities become increasingly dominant for assembly, service, maintenance functions to support GEO, Moon, Mars, and interplanetery missions and to serve as a nodal point for space transportation systems, (i.e., evolution towards full European space station capabilities). ESA

N88-17690# Moreton Hall Associates, Maidenhead (England).
STUDY FOR HISTORY OF TECHNOLOGY DEVELOPMENTS IN EUROPEAN SPACE PROJECTS
G. E. Hall, comp. and R. D. Hunt, comp. (Spur Electron Ltd., Havant, England) Paris, France ESA Feb. 1987 47 p
(Contract ESA-6361/85-NL-PP(SC))
(Rept-8518-1; ESA-CR(P)-2511; ETN-88-91706) Avail: NTIS HC A03/MF A01

The technologies used in European spacecraft from 1965 to 1986 were reviewed, and 890 ESRO/ESA contracts for the period were examined. A unique technology development model to which all investigated technologies conform is identified. Of three main technology decision-making criteria (technical, cost, and industrial policy), much evidence of industrial policy shows up. Analysis of utilization decisions highlights a reluctance to use newly developed technology because of conservatism among spacecraft design decision makers. Technologies started to satisfy a project need show a much better utilization picture than those begun for R and D reasons. Technologies utilized performed well in orbit. Monitoring of funding and planning effectiveness is hampered by the lack of firm, documented planning data and its limited availability time span. ESA

N88-17691*# National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, Md.
THE 1987 GET AWAY SPECIAL EXPERIMENTER'S SYMPOSIUM
Neal Barthelme, ed. and Frances L. Mosier, ed. (RMS Technologies, Inc., Landover, Md.) Feb. 1988 169 p Symposium held in Greenbelt, Md., 27-28 Oct. 1987
(NASA-CP-2500; Rept-88B0049; NAS 1.55:2500) Avail: NTIS HC A08/MF A01 CSCL 22A

The 1987 Get Away Special (GAS) Experimenter's symposium provides a formal opportunity for GAS Experimenter's to share the results of their projects. The focus of this symposium was on payloads that were flown on Shuttle missions, and on GAS payloads that will be flown in the future. For individual titles, see N88-17692 through N88-17712.

N88-17692*# Universidad Nacional Autonoma de Mexico, Mexico City.
MICROGRAVITY RESEARCH AT THE UNIVERSITY OF MEXICO: EXPERIMENTS IN PAYLOAD G-006 **c29**
Ricardo Peralta-Fabi and Javier Mendieta-Jimenez (Instituto de Investigaciones Electricas, Palmira, Mexico) *In* NASA. Goddard Space Flight Center, The 1987 Get Away Special Experimenter's Symposium Feb. 1988 p 1-7 Sponsored by CONACYT and SCT, Mexico (For primary document see N88-17691 10-12)
Avail: NTIS HC A08/MF A01 CSCL 22A

The experiments contained in the G-006 payload related to thin film vapor deposition, vacuum variations in a chamber vented to space, solidification of a Zn-Al-Cu alloy, and multiple location temperature monitoring for thermal model validation are described in detail. A discussion of the expected results is presented, together with the methods selected to conduct the postflight analysis, and finally, a overview of the future activities in this field. Author

N88-17693*# Marshall Amateur Radio Club, Huntsville, Ala.
MARCE DATA EVALUATION **c32**
Edward F. Stluka *In* NASA. Goddard Space Flight Center, The 1987 Get Away Special Experimenter's Symposium Feb. 1988 p 9-16 (For primary document see N88-17691 10-12)
Avail: NTIS HC A08/MF A01 CSCL 17B

The Get Away Special (GAS) 007 Project Explorer Experiment data recorded and radio downlinked by the Marshall Amateur Radio Club Experiment (MARCE), the first GAS radio experiment, are compared and evaluated. A compatibility assessment, of the student experiments and the MARCE power, control and data systems, during the STS-61C Columbia flight in January 1986 is presented. Analysis of the GAS container's thermal environment, located near the center of the GAS Bridge is discussed. Author

N88-17694*# Saint Mary's Coll., Notre Dame, Ind.
LASER INVESTIGATIONS FOR PAYLOAD G-652 PRIOR TO FILING PRE-FLIGHT ACCOMMODATION REQUIREMENTS **c36**
Joseph Bellina and M. C. Muckerheide (Saint Mary's Hospital, Milwaukee, Wis.) *In* NASA. Goddard Space Flight Center, The 1987 Get Away Special Experimenter's Symposium Feb. 1988 p 17-22 (For primary document see N88-17691 10-12)
Avail: NTIS HC A08/MF A01 CSCL 20E

In anticipation of presenting the preflight accommodations requirements to NASA for approval, the physics, biology, electronic and chemistry aspects of laser experiments which are most advantageous to the flight are investigated. Preliminary laboratory evaluation was targeted with the realization that future flights of the shuttle may begin in 1988. It is the consensus that during the holding time before the resumption of flights, there is an extra margin of perfection which is possible and that the period prior to flight is advantageous technologically. The problems that can be encountered in space flown laser systems are addressed and the analysis of data is offered as a model for preflight accommodation requirement filing. Author

N88-17695*# San Jose State Univ., Calif.
MATERIALS PROCESSING IN SPACE: AN INTRODUCTION TO THE G-480 PAYLOAD
Steven J. Butow *In* NASA. Goddard Space Flight Center, The 1987 Get Away Special Experimenter's Symposium Feb. 1988 p 23-30 (For primary document see N88-17691 10-12)
Avail: NTIS HC A08/MF A01 CSCL 22A

The Space Research and Development Organization at San Jose State University designed and developed a small self-contained payload (designated G-480 by NASA) which will perform four materials science experiments in low Earth orbit aboard the Space Shuttle. These experiments are categorized under two areas of investigation: corrosion and electrodeposition. While none of these experiments have previously been performed in space, both government and industry have expressed great interest in these and related areas of materials processing and engineering. A brief history of the G-480 project development is given along with a description of each experiment, followed by a tour of the G-480 payload. Expected results are discussed along with the function, design and operation of the payload hardware and software. Author

N88-17696*# Deutsche Forschungs- und Versuchsanstalt fuer Luft- und Raumfahrt, Cologne (West Germany).
TEN PAST AND TEN FUTURE GAS/MAUS-PAYLOADS c29
S. Staniek, G. Otto, and J. Doepkess (Messerschmitt-Boelkow-Blohm G.m.b.H., Bremen, West Germany) *In* NASA. Goddard Space Flight Center, The 1987 Get Away Special Experimenter's Symposium Feb. 1988 p 31-38 (For primary document see N88-17691 10-12)
Avail: NTIS HC A08/MF A01 CSCL 22A

MAUS (materials science autonomous experiments) is one out of a series of flight opportunities which the Space Program of West Germany offers to scientists from the disciplines of materials research and processing for performing materials science investigations under microgravity conditions. Up to now, ten MAUS experiments were flown which were dealing with the following scientific topics: decomposition of binary alloys with miscibility gap in the liquid state, interaction of a solidification front with dispersed particles, critical Marangoni number, investigation of the magnetic compound MnBi, shrinkage of gas bubbles in glass melts and slip casting. The ten future experiments are partly reflights with modification of the scientific objectives as well as new experiments in the fields of chemical reactions, heat transfer, glass technology and Ostwald ripening. Looking to ten flown payloads, the peculiarities of instrument technology in GAS-cans and its evolution is discussed with emphasis on structure, electronics and thermal design. A typical modern payload using 100 percent of the resource is presented. Author

N88-17697*# Worcester Polytechnic Inst., Mass. Dept. of Electrical Engineering.
AN UPDATE TO THE MITRE/WPI SPACE SHUTTLE PROGRAM GASCAN G-408 c29
F. J. Looft and W. D. Durgin *In* NASA. Goddard Space Flight Center, The 1987 Get Away Special Experimenter's Symposium Feb. 1988 p 39-46 (For primary document see N88-17691 10-12)
Avail: NTIS HC A08/MF A01 CSCL 22A

The objective of the MITRE/WPI Space Shuttle Program was to develop a set of scientific meaningful experiments that could be flown in a Get Away Special Canister. Currently, the first GASCAN is finished (G-408) and ready to be launched. The program has been so successful that the design and development of a second set of experiments was started (G-533). Both of these programs are described and summarized. Author

N88-17698*# National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, Md.
ELECTROCHEMICAL GROWTH OF LINEAR CONDUCTING CRYSTALS IN MICROGRAVITY c29
Raymond J. Cronise, IV *In its* The 1987 Get Away Special Experimenter's Symposium Feb. 1988 p 47-53 Sponsored in part by Westinghouse Electric Corp., Baltimore, Md. (For primary document see N88-17691 10-12)
Avail: NTIS HC A08/MF A01 CSCL 22A

Much attention has been given to the synthesis of linear conducting materials. These inorganic, organic, and polymeric materials have some very interesting electrical and optical properties, including low temperature superconductivity. Because of the anisotropic nature of these compounds, impurities and defects strongly influences the unique physical properties of such crystals. Investigations have demonstrated that electrochemical growth has provided the most reproducible and purest crystals. Space, specifically microgravity, eliminates phenomena such as buoyancy driven convection, and could permit formation of crystals many times purer than the ones grown to date. Several different linear conductors were flown on Get Away Special G-007 on board the Space Shuttle Columbia, STS 61-C, the first of a series of Project Explorer payloads. These compounds were grown by electrochemical methods, and the growth was monitored by photographs taken throughout the mission. Due to some thermal problems, no crystals of appreciable size were grown. The experimental results will be incorporated into improvements for the next 2 missions of Project Explorer. The results and conclusions of the first mission are discussed. Author

N88-17699*# National Aeronautics and Space Administration. Langley Research Center, Hampton, Va.
PLANET X PROBE: A FRESH NEW LOOK AT AN OLD FAMILIAR PLACE c43
James Nicholson, Tom OBrien, Sharon Brower (Charleston County Public School District, S.C.), and Shelley Canright *In* NASA. Goddard Space Flight Center, The 1987 Get Away Special Experimenter's Symposium Feb. 1988 p 55-62 (For primary document see N88-17691 10-12)
Avail: NTIS HC A08/MF A01 CSCL 08B

Planet X Probe utilizes a Get Away Special (GAS) payload to provide a large student population with a remote Earth sensing experimental package. To provide a cooperative as well as a competitive environment, the effort is targeted at all grade levels and at schools in different geographical regions. LANDSAT capability allows students to investigate the Earth, its physical makeup, its resources, and the impact of man. This project also serves as an educational device to get students to stand back and take a fresh look at their home planet. The key element is to treat the familiar Earth as an unknown planet with knowledge based only on what is observable and provable from the images obtained. Through participation, a whole range of experiences will include: (1) mission planning; (2) research and pilot projects to train teams; (3) identification and recruitment of scientific mentors and dialogue; (4) selection of a student advisory team to be available during the mission; (5) analysis of data and compilation of findings; (6) report preparation, constucted along sound scientific principles; and (7) presentation and defense of findings before a meeting of competitive student groups and scientist in the field. Author

N88-17700*# Fujitsu Ltd., Atsugi (Japan).
PROTEIN-CRYSTAL GROWTH EXPERIMENT (PLANNED) c29
S. Fujita, K. Asano, T. Hashitani, T. Kitakohji, H. Nemoto, and S. Kitamura (Fujitsu Ltd., Kwasaki, Japan) *In* NASA. Goddard Space Flight Center, The 1987 Get Away Special Experimenter's Symposium Feb. 1988 p 63-68 (For primary document see N88-17691 10-12)
Avail: NTIS HC A08/MF A01 CSCL 22A

To evaluate the effectiveness of a microgravity environment on protein crystal growth, a system was developed using 5 cubic feet Get Away Special payload canister. In the experiment, protein (myoglobin) will be simultaneously crystallized from an aqueous solution in 16 crystallization units using three types of crystallization methods, i.e., batch, vapor diffusion, and free interface diffusion. Each unit has two compartments: one for the protein solution and the other for the ammonium sulfate solution. Compartments are separated by thick acrylic or thin stainless steel plates. Crystallization will be started by sliding out the plates, then will be

periodically recorded up to 120 hours by a still camera. The temperature will be passively controlled by a phase transition thermal storage component and recorded in IC memory throughout the experiment. Microgravity environment can then be evaluated for protein crystal growth by comparing crystallization in space with that on Earth. Author

N88-17701*# Herzberg Inst. of Astrophysics, Ottawa (Ontario).
THE PHOTONS PAYLOAD, G-494: A LEARNING EXPERIENCE **c43**
F. R. Harris, R. L. Gattinger, F. Creutzberg, and E. J. Llewellyn (Saskatchewan Univ., Saskatoon.) *In* NASA. Goddard Space Flight Center, The 1987 Get Away Special Experimenter's Symposium Feb. 1988 p 69-76 (For primary document see N88-17691 10-12)
Avail: NTIS HC A08/MF A01 CSCL 08B

PHOTONS (Photometric Thermospheric Oxygen Nightglow Study) is an optical remote sensing payload developed for Get Away Special (GAS) flight by the National Research Council of Canada. The device is extremely sensitive and is suitable for making measurements of low intensity, aeronomically generated atmospheric emissions in the nadir and the limb and of Shuttle ram glow. The unit uses a sealed canister and UV transmitting viewing ports. During the flight of STS 61-C, PHOTONS received one hour of operation and aeronomic observations were made. Good diagnostic data were obtained and the science part of the experiment malfunctioned. Post flight inspection revealed that the payload was in perfect working order except for total failure of the photomultiplier detectors. The experiment and the payload are described and the flight results are discussed along with the cause of the malfunctions. It is shown that enough was learned from the flight diagnostic data and about the cause of the malfunction to conclude that the engineering flight was successful and that subsequent flight of the PHOTONS payload will be productive. Author

N88-17702*# GTE Labs., Inc., Waltham, Mass.
A PAYLOAD FOR INVESTIGATING THE INFLUENCE OF CONVECTION ON GaAs CRYSTAL GROWTH **c76**
Alfred H. Bellows and Glenn A. Duchene *In* NASA. Goddard Space Flight Center, The 1987 Get Away Special Experimenter's Symposium Feb. 1988 p 77-82 (For primary document see N88-17691 10-12)
(Contract NAS3-24644)
Avail: NTIS HC A08/MF A01 CSCL 20L

A comparative study of the influence of buoyancy driven fluid flow on gallium arsenide (GaAs) crystal growth was undertaken. Crystals will be grown from melts with different degrees of convective flow including growth in the microgravity environment of space. The space growth of GaAs will be performed in a Get Away Special payload. A well insulated growth furnace was designed for both Earth-based and space-based experiments. The self contained payload will carry two such furnaces in addition to a large battery power source and a microprocessor-based control and data acquisition system for regulating the growth process with high precision. The microcomputer will also monitor the growth conditions and measure and record the acceleration in 3 axes. Author

N88-17703*# Swedish Space Corp., Stockholm.
AN ADVANCED MICROCOMPUTER DESIGN FOR PROCESSING OF SEMICONDUCTOR MATERIALS **c29**
L. Bjoern, L. Lindkvist, and J. Zaar *In* NASA. Goddard Space Flight Center, The 1987 Get Away Special Experimenter's Symposium Feb. 1988 p 83-88 (For primary document see N88-17691 10-12)
Avail: NTIS HC A08/MF A01 CSCL 22A

In the Get Away Special 330 payload two germanium samples doped with gallium will be processed. The aim of the experiments is to create a planar solid/liquid interface, and to study the breakdown of this interface as the crystal growth rate increases. For the experiments a gradient furnace was designed which is heated by resistive heaters. Cooling is provided by circulating gas from the atmosphere in the cannister through cooling channels in the furnace. The temperature along the sample are measured by platinum/rhodium thermocouples. The furnace is controlled by a microcomputer system, based upon the processor 80C88. A data acquisition system is integrated into the system. In order to synchronize the different actions in time, a multitask manager is used. Author

N88-17704*# Tohoku Univ., Sendai (Japan). Faculty of Science.
APPLICATION OF HOFFMAN MODULATION CONTRAST MICROSCOPY COUPLED WITH THREE-WAVELENGTH TWO-BEAM INTERFEROMETRY TO THE IN SITU DIRECT OBSERVATION OF THE GROWTH PROCESS OF A CRYSTAL IN MICROGRAVITY **c29**
Katsuo Tsukamoto *In* NASA. Goddard Space Flight Center, The 1987 Get Away Special Experimenter's Symposium Feb. 1988 p 89-98 (For primary document see N88-17691 10-12)
Avail: NTIS HC A08/MF A01 CSCL 22A

Direct visualization of three dimensional transfer process of both heat and mass around a growing crystal and mono-molecular growth layers on the surface is possible in situ by means of high resolution Hoffman modulation contrast microscopy coupled with three wavelength two beam Mach-Zehnder interferometry. This in situ observation is very suitable for the verification of the growth mechanism of a crystal in a solution or a melt in microgravity. Author

N88-17705*# Orbital Systems Ltd., Lanham, Md.
THE CHALLENGE OF G-376 **c29**
George L. Dorsey *In* NASA. Goddard Space Flight Center, The 1987 Get Away Special Experimenter's Symposium Feb. 1988 p 99-105 (For primary document see N88-17691 10-12)
Avail: NTIS HC A08/MF A01 CSCL 22A

The entire G-376 project is reviewed from history, experiment concept, construction, testing, through post flight data reduction. For each of these topics, one or two specific experiments is used as an example to develop that topic. A summary of the 14 experiments is given in tabular form. Author

N88-17706*# City Coll. of the City Univ. of New York. Dept. of Science.
DROSOPHILA GEOTAXIS AS A TOOL FOR THE STUDY OF AGING **c51**
Edgar M. Schnebel, R. Nicholas Hoffmann, and Joe Grossfield *In* NASA. Goddard Space Flight Center, The 1987 Get Away Special Experimenter's Symposium Feb. 1988 p 107-113 (For primary document see N88-17691 10-12)
Avail: NTIS HC A08/MF A01 CSCL 06B

Age dependent changes in geotaxis profiles were examined in 27 wild-type populations of Drosophila, representing a diversity of species, semispecies and strains. In addition, four strains of D. melanogaster were tested. Tests were carried out at a minimum of three test ages, and involve the use of a calibrated, adjustable inclined plane that can be set at any angle between 0 and 85 deg. Among selected lines, decline in geotactic response occurs later in the long lived flies than in the controls. Longer lived flies continue to show an increase in negative geotactic response through age 14 days. These results suggest that common processes may be influencing the rate of decline in geotactic response and longevity. Further analysis of the mechanisms underlying age dependent changes in geotaxis may reveal factors which influence the aging process itself. The use of geotaxis aging markers in a broad range of Drosophila species reflecting varying degrees of genetic relatedness is proposed to test the universality vs. specificity of aging processes. Author

N88-17707*# Redstone Scientific Information Center, Redstone Arsenal, Ala.
PROJECT EXPLORER TAKES ITS SECOND STEP: GAS-608 IN ENGINEERING DEVELOPMENT **c29**
Philip H. Kitchens *In* NASA. Goddard Space Flight Center, The 1987 Get Away Special Experimenter's Symposium Feb. 1988

p 115-119 (For primary document see N88-17691 10-12)
Avail: NTIS HC A08/MF A01 CSCL 22A

An a continuation of its Project Explorer series, the Alabama Space and Rocket Center is sponsoring the development of two additional Get Away Special payloads. Details are given of GAS-608, including descriptions of its six experiments in organic crystal growth, roach eggs, yeast, radish seeds, bacterial morphology, and silicon crystals. A brief summary is also presented of GAS-105 and the Space Camp program for stimulating student first hand participation in space flight studies. GAS-608 will carry six student experiments, which will involve biology, crystal growth, and biochemistry in addition to a centralized package for electronics and power supply. Author

N88-17708*# California State Polytechnic Coll., San Luis Obispo. Space Project.
A RELIABLE DATA COLLECTION/CONTROL SYSTEM c29
Thom Maughan *In* NASA. Goddard Space Flight Center, The 1987 Get Away Special Experimenter's Symposium Feb. 1988 p 121-126 (For primary document see N88-17691 10-12)
Avail: NTIS HC A08/MF A01 CSCL 22A

The Cal Poly Space Project requires a data collection/control system which must be able to reliably record temperature, pressure and vibration data. It must also schedule the 16 electroplating and 2 immiscible alloy experiments so as to optimize use of the batteries, maintain a safe package temperature profile, and run the experiment during conditions of microgravity (and minimum vibration). This system must operate unattended in the harsh environment of space and consume very little power due to limited battery supply. The design of a system which meets these requirements is addressed. Author

N88-17709*# American Inst. of Aeronautics and Astronautics, New York, N.Y.
GAS 450: A SPACE PAYLOAD FOR THE PEOPLE CENTRAL COAST STUDENT EXPERIMENTERS c29
Glen Ray *In* NASA. Goddard Space Flight Center, The 1987 Get Away Special Experimenter's Symposium Feb. 1988 p 127-132 (For primary document see N88-17691 10-12)
Avail: NTIS HC A08/MF A01 CSCL 22A

The Get Away Special 450 is described. This discussion includes the peoples efforts, the experiments, lessons learned, and a few powerful positive steps toward community involvement. The following is a list of experiment titles: Guppies in Space; Electrophoresis of Enzymes in Microgravity; Diffusion of Ions in Solution; Space Cement; Bubbles in Space; Small Particle Studies; and Liquid Separation in Microgravity. Author

N88-17710*# Norfolk Public Schools, Va. Science and Technology Advanced Research.
THE NORSTAR PROGRAM: SPACE SHUTTLE TO SPACE STATION
Ronald C. Fortunato *In* NASA. Goddard Space Flight Center, The 1987 Get Away Special Experimenter's Symposium Feb. 1988 p 133-140 (For primary document see N88-17691 10-12)
Avail: NTIS HC A08/MF A01 CSCL 22A

The development of G-325, the first high school student-run space flight project, is updated. An overview is presented of a new international program, which involves students from space station countries who will be utilizing Get Away Special technology to cooperatively develop a prototype experiment for controlling a space station research module environment. Author

N88-17711*# Federal Aviation Administration, Washington, D.C.
LIGHTSATS AND THEIR ATTRACTION TO BUDGET ORIENTED FEDERAL AGENCIES c18
Charles A. Bonsall *In* NASA. Goddard Space Flight Center, The 1987 Get Away Special Experimenter's Symposium Feb. 1988 p 141-146 (For primary document see N88-17691 10-12)
Avail: NTIS HC A08/MF A01 CSCL 22B

The term Lightsats refers to low volume, low mass, low Earth orbit, satellites suitable for launch from Get Away Special canisters, or as secondary payloads on expendable launch vehicles. New or existing technology that offers potential to improve the safety, capacity and efficiency of the National Airspace System is discussed. The discussion is presented from the point of view of an individual within a government agency who wants to see a new technology to enhance the mission of that agency. Author

N88-17712*# National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, Md.
GAS ELEVEN NODE THERMAL MODEL (GEM) c29
Dan Butler *In its* The 1987 Get Away Special Experimenter's Symposium Feb. 1988 p 147-169 (For primary document see N88-17691 10-12)
Avail: NTIS HC A08/MF A01 CSCL 22A

The Eleven Node Thermal Model (GEM) of the Get Away Special (GAS) container was originally developed based on the results of thermal tests of the GAS container. The model was then used in the thermal analysis and design of several NASA/GSFC GAS experiments, including the Flight Verification Payload, the Ultraviolet Experiment, and the Capillary Pumped Loop. The model description details the five cu ft container both with and without an insulated end cap. Mass specific heat values are also given so that transient analyses can be performed. A sample problem for each configuration is included as well so that GEM users can verify their computations. The model can be run on most personal computers with a thermal analyzer solution routine. Author

N88-17713# National Defense Univ., Washington, D. C.
AMERICA PLANS FOR SPACE
1986 201 p
(AD-A187465) Avail: NTIS HC A10/MF A01 CSCL 22A

A report on America's future plans for space exploration contains the following: Pursuing a Balanced Space Program; The Space Defense Initiative; Warfare in Space; The Lunar Laboratory; The Role of Space in Preserving the Peace; Living off the Land-the Use of Resources in Space for Future Civilian Space Operations; The Military Uses of Space; C3I(Command Control Communications and Intelligence); Aspects of Space Technology; Arms Control in Space: Preserving Critical Strategic Space Systems Without Weapons in Space; Space and Arms Control: A Skeptical View; Options for Space Arms Control; Space Arms Control. GRA

13 ASTRODYNAMICS

Includes powered and free-flight trajectories; and orbital and launching dynamics.

No abstracts in this category.

14 GROUND SUPPORT SYSTEMS AND FACILITIES (SPACE)

Includes launch complexes, research and production facilities; ground support equipment, e.g., mobile transporters; and simulators.

For related information see also *09 Research and Support Facilities (Air).*

N88-17714# Princeton Univ., N. J. Dept. of Mechanical and Aerospace Engineering.
DEVELOPMENT AND APPLICATION OF OXYGEN FLOW TAGGING FOR VELOCITY MEASUREMENTS AND FLOW VISUALIZATION IN TURBULENT THREE-DIMENSIONAL SUPERSONIC FLOWS Annual Technical Report, 1 Jun. 1986 - 31 May 1987

Richard B. Miles 10 Sep. 1987 38 p
(Grant AF AFOSR-0191-86)
(AD-A187982; AFOSR-87-1707TR) Avail: NTIS HC A03/MF A01 CSCL 14B

During this first year, research has concentrated on the acquisition of laser systems and the construction of the test facility. Two major research milestones have been achieved, i.e., the demonstration of velocity tagging, and the demonstration of the simultaneous measurement of two-dimensional temperature and pressure fields. Currently being studied are the nonlinear effects associated with high intensity laser fields with a particular interest in how they affect the measurements of flow properties. GRA

15 LAUNCH VEHICLES AND SPACE VEHICLES

Includes boosters; operating problems of launch/space vehicle systems; and reusable vehicles.

For related information see also *20 Spacecraft Propulsion and Power.*

N88-17715*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.
SIMULATION TEST BEDS FOR THE SPACE STATION ELECTRICAL POWER SYSTEM
Gerald G. Sadler Mar. 1988 20 p
(NASA-TM-100786; E-3958; NAS 1.15:100786) Avail: NTIS HC A03/MF A01 CSCL 22B

NASA Lewis Research Center and its prime contractor are responsible for developing the electrical power system on the space station. The power system will be controlled by a network of distributed processors. Control software will be verified, validated, and tested in hardware and software test beds. Current plans for the software test bed involve using real time and nonreal time simulations of the power system. This paper will discuss the general simulation objectives and configurations, control architecture, interfaces between simulator and controls, types of tests, and facility configurations. Author

N88-17832# Bolkow Entwicklungen K. G., Munich (West Germany). Entwicklungsfachabteilung Triebwerke.
CALCULATION AND DESIGN OF A RAMJET MISSILE [BERECHNUNG UND ENTWURF EINER STAUSTRAHLRAKETE]
Johannes Schubert *In* MBB GmbH, Research and Development. Technical-Scientific Publications (1956-1987): Retrospective View and Prospects. Jubilee Edition on the Occasion of the 75th Anniversary of Dipl.-Engr. Dr.-Engr. E.H. Ludwig Boelkow 1987 p 93-96 In GERMAN (For primary document see N88-17819 10-31)
(Rept-TR-500) Copyright Avail: NTIS HC A14/MF A01

N88-17862# Messerschmitt-Boelkow-Blohm G.m.b.H., Ottobrunn (West Germany). Unternhemensgruppe Wehrtechnik.
POLYPHEM, A UNIVERSAL DEFENSIVE MISSILE WITH OPTICAL WAVEGUIDES GUIDANCE [POLYPHEM - EIN UNIVERSELLER ABWEHR-FLUGKOERPER MIT LICHTWELLENLIETERLENKUNG]
Karl Heinz Niederhofer, Wolfgang vonHoessle, and Wolf-Dieter Schuck *In its* Research and Development. Technical-Scientific Publications (1956-1987): Retrospective View and Prospects. Jubilee Edition on the Occasion of the 75th Anniversary of Dipl.-Engr. Dr.-Engr. E.H. Ludwig Boelkow (date) 285-288 (SEE N88-17819 10-31) 1987 In GERMAN (For primary document see N88-17819 10-31)
(MBB-UA-1045/87) Copyright Avail: NTIS HC A14/MF A01

16 SPACE TRANSPORTATION

Includes passenger and cargo space transportation, e.g., shuttle operations; and space rescue techniques.

For related information see also *03 Air Transportation and Safety* and *18 Spacecraft Design, Testing and Performance.* For space suits see *54 Man/System Technology and Life Support.*

N88-17716*# Martin Marietta Aerospace, New Orleans, La.
STS PROPELLANT SCAVENGING SYSTEMS STUDY. PART 2, VOLUME 1: EXECUTIVE SUMMARY AND STUDY RESULTS Final Report
Frank L. Williams Jun. 1987 114 p
(Contract NAS8-35614)
(NASA-CR-179275; NAS 1.26:179275) Avail: NTIS HC A06/MF A01 CSCL 22B

The major objective of the STS Propellant Scavenging Study is to define the hardware, operations, and life cycle costs for recovery of unused Space Transportation System propellants. Earlier phases were concerned exclusively with the recovery of cryogenic propellants from the main propulsion system of the manned STS. The phase of the study covered by this report (Part II Extension) modified the objectives to include cryogenic propellants delivered to orbit by the unmanned cargo vehicle. The Part II Extension had the following objectives: (1) predict OTV propellant requirements from 1995 to 2010; investigate scavenging/transport tank reuse; determine optimum tank sizing and arrangement; and develop hardware concepts for tanks. F.M.R.

N88-17717*# Martin Marietta Aerospace, New Orleans, La.
STS PROPELLANT SCAVENGING SYSTEMS STUDY. PART 2, VOLUME 2: COST AND WBS/DICTIONARY Final Report
Frank L. Williams Jun. 1987 72 p
(Contract NAS8-35614)
(NASA-CR-179276; NAS 1.26:179276) Avail: NTIS HC A04/MF A01 CSCL 22B

Presented are the results of the cost analysis performed to update and refine the program phase C/D cost estimates for a Shuttle Derived Vehicle (SDV) tanker. The SDV tanker concept is an unmanned cargo vehicle incorporating a set of propellant tanks in the vehicle's payload module. The tanker will be used to meet the demand for a cryogenic propellant supply in orbit. The propellant tanks are delivered to a low Earth orbit or to an orbit in the vicinity of the Space Station. The intent of the economic analysis is to provide NASA with economic justification for the propellant scavenging concept that minimizes the total Space Transportation System life cycle cost. The detailed costs supporting the concept selection process are presented with descriptive text to aid in forecasting the phase C/D project and program planning. Included are all propellant scavenging costs as well as all SDV, STS and Orbital Maneuvering Vehicle charges to deliver the propellants to the Space Station. F.M.R.

N88-17828# Messerschmitt-Boelkow-Blohm G.m.b.H., Ottobrunn (West Germany). Space Div.
BALLISTIC SINGLE STAGE CARRIER VEHICLE (BETA): A SINGLE STAGE REUSABLE BALLISTIC SPACE SHUTTLE CONCEPT
Dietrich E. Koelle *In its* Research and Development. Technical-Scientific Publications (1956-1987): Retrospective View and Prospects. Jubilee Edition on the Occasion of the 75th Anniversary of Dipl.-Engr. Dr.-Engr. E.H. Ludwig Boelkow 1987 p 71-74 Presented at the 21st International Astronautical Congress, Konstanz, Fed. Republic of Germany, 4-10 Sep. 1970 (For primary document see N88-17819 10-31)
(MBB-UR-949/70) Copyright Avail: NTIS HC A14/MF A01

N88-17857# Messerschmitt-Boelkow-Blohm G.m.b.H., Ottobrunn (West Germany). Unternehmensgruppe Raumfahrt.
TRENDS IN THE DEVELOPMENT OF SPACE TRANSPORTATION SYSTEMS [ENTWICKLUNGSTENDENZEN BEI RUAMTRANSPORTERN]

Ernst Hoegenauer *In its* Research and Development. Technical-Scientific Publications (1956-1987): Retrospective View and Prospects. Jubilee Edition on the Occasion of the 75th Anniversary of Dipl.-Engr. Dr.-Engr. E.H. Ludwig Boelkow 1987 p 251-256 In GERMAN (For primary document see N88-17819 10-31)
(MBB-UR-911/86) Copyright Avail: NTIS HC A14/MF A01

17 SPACE COMM., SPACECRAFT COMM., COMMAND & TRACKING

Includes telemetry; space communications networks; astronavigation and guidance; and radio blackout.

For related information see also *04 Aircraft Communications and Navigation* and *32 Communications and Radar.*

No abstracts in this category.

18 SPACECRAFT DESIGN, TESTING AND PERFORMANCE

Includes satellites; space platforms; space stations; spacecraft systems and components such as thermal and environmental controls; and attitude controls.

For life support systems see *54 Man/System Technology and Life Support.* For related information see also *05 Aircraft Design, Testing and Performance, 39 Structural Mechanics,* and *16 Space Transportation.*

N88-17718# Naval Postgraduate School, Monterey, Calif.
INVESTIGATION OF DESIGN CONSIDERATIONS FOR TELEMETRY, TRACKING AND COMMAND (TT AND C) ANTENNA SYSTEM ON NAVAL POSTGRADUATE SCHOOL ORION MINI-SATELLITE M.S. Thesis
David L. Peters Sep. 1987 73 p
(AD-A187130) Avail: NTIS HC A04/MF A01 CSCL 09A

The design requirements for the telemetry, tracking, and command (TT&C) antenna system on the proposed Naval Postgraduate School Orion mini-satellite are investigated. Initial design criteria were developed by examination of the satellite itself, including launch vehicles, orbital profiles and ground interfaces. After consideration of these design constraints, a review of commercially available TT&C antennas was conducted to determine compatibility with Orion, cumulating in recommendation of the conical log-spiral as the primary candidate for use on the spacecraft. The conical log-spiral is a low cost, space-qualified antenna capable of providing broadband omni-directional circularly polarized radiation from space, while fulfilling pattern coverage, space-ground link power margin, and transmitter-receiver isolation requirements for the Orion mini-satellite. GRA

N88-17719# Messerschmitt-Boelkow-Blohm G.m.b.H., Bremen (West Germany). Dept. for Ariane and Launcher Systems.
RENDEZVOUS AND DOCKING VERIFICATION AND DEMONSTRATION IN ORBIT, EXECUTIVE SUMMARY
A. Getzschmann and D. Grimbert (MATRA Espace, Toulouse, France) Paris, France ESA Dec. 1986 120 p
(Contract ESA-6492/85-NL-AN(SC))
(MBB-303-16/86; ESA-CR(P)-2487; MBB-RVD-RVDV-SVS-REP-ERNO-01; ETN-88-91700) Avail: NTIS HC A06/MF A01

The feasibility of a rendezvous and docking (RVD) mission in LEO using EURECA, to demonstrate an LEO dedicated RVD concept and for geostationary RVD demonstration in LEO was analyzed. Adequate verification methods for all RVD equipment and functions were identified. The purpose and logic of the ground test facilities within the development and verification phase of the RVD equipment and functions are outlined. The distinction between verification and validation is emphasized. Verification is concerned with all activities which prove that a design or performance feature is in accordance with a specification. Validation activities prove that the item or process is compatible with the reality, which includes to a certain extent also a verification of the specification. The demonstration mission constraints were identified and a mission timetable was established. ESA

N88-17720*# Lockheed Missiles and Space Co., Palo Alto, Calif. Research and Development
STUDY OF HELIUM TRANSFER TECHNOLOGY FOR STICCR: FLUID MANAGEMENT
D. J. Frank, S. W. K. Yuan, R. K. Grove, and J. M. LHeureux Jul. 1987 116 p
(Contract NAS2-12051)
(NASA-CR-177463; NAS 1.26:177463) Avail: NTIS HC A06/MF A01 CSCL 22A

The Space Infrared Telescope Facility (SIRTF) is a long life cryogenically cooled space based telescope for infrared astronomy from 2 to 700 microns currently under study and planned for launch in the mid 90's. SIRTF will operate as a multi-user facility, initially carrying 3 instruments at the focal plane. It will be cooled to below 2 K by superfluid liquid helium to achieve radiometric sensitivity limited only by the statistical fluctuations in the natural infrared background radiation over most of its spectral range. The lifetime of the mission will be limited by the lifetime of the liquid helium supply, and is currently baselined to be 2 years. Candidates are reviewed for a liquid management device to be used in the resupply of liquid helium, and for the selection of an appropriate candidate. Author

N88-17721*# Boeing Aerospace Co., Seattle, Wash.
SYSTEM ANALYSIS STUDY OF SPACE PLATFORM AND STATION ACCOMMODATIONS FOR LIFE SCIENCES RESEARCH FACILITIES. VOLUME 1: EXECUTIVE SUMMARY. PHASE A: CONCEPTUAL DESIGN AND PROGRAMMATICS Final Report
Oct. 1985 43 p
(Contract NAS8-35471)
(NASA-CR-179268; NAS 1.26:179268; D180-27863-1-Vol-1; DPD-614-Vol-1; DR-5-Vol-1) Avail: NTIS HC A03/MF A01 CSCL 22B

The study was conducted in 3 parts over a 3 year period. The study schedule and the documentation associated with each study part is given. This document summarized selected study results from the conceptual design and programmatics segment of the effort. The objectives were: (1) to update requirements and tradeoffs and develop a detailed design and mission requirements document; (2) to develop conceptual designs and mission descriptions; and (3) to develop programmatic, i.e., work breakdown structure and work breakdown structure dictionary, estimated cost, and implementing plans and schedules. Author

N88-17722*# Boeing Aerospace Co., Seattle, Wash.
SYSTEM ANALYSIS STUDY OF SPACE PLATFORM AND STATION ACCOMMODATIONS FOR LIFE SCIENCES RESEARCH FACILITIES. VOLUME 2: STUDY RESULTS, ATTACHMENT 2. PHASE A: CONCEPTUAL DESIGN AND PROGRAMMATICS Final Report
Lowell F. Wiley Oct. 1985 107 p
(Contract NAS8-35471)
(NASA-CR-179272; NAS 1.26:179272; D180-27863-2-Vol-2; DPD-614-Vol-2; DR-5-Vol-2) Avail: NTIS HC A06/MF A01 CSCL 22B

The study results from the conceptual design and programmatics segment of the Space Platform and Station Accommodation for Life Sciences Research Facilities. The results and significant findings of the conceptual design and programmatics were generated by these tasks: (1) the review and update engineering and science requirements; (2) analysis of life sciences mission transition scenario; (3) the review and update of key trade issues; (4) the development of conceptual definition and designs;

and (5) the development of the work breakdown schedule and its dictionary, program schedule, and estimated costs. Author

N88-17723*# Boeing Aerospace Co., Seattle, Wash.
SYSTEM ANALYSIS STUDY OF SPACE PLATFORM AND STATION ACCOMMODATIONS FOR LIFE SCIENCES RESEARCH FACILITIES. VOLUME 2: STUDY RESULTS. APPENDIX E: WORK BREAKDOWN STRUCTURE AND DICTIONARY Final Report
Lowell F. Wiley Oct. 1985 115 p
(Contract NAS8-35471)
(NASA-CR-179274; NAS 1.26:179274; D180-27863-2-Vol-2-App-E; DPD-614-Vol-2-App-E; DR-4-Vol-2-App-E) Avail: NTIS HC A06/MF A01 CSCL 22B

A work breakdown structure for the Space Station Life Sciences Research Facility (LSRF) is presented up to level 5. The purpose is to provide the framework for task planning and control and to serve as a basis for budgeting, task assignment, cost collection and report, and contractual performance measurement and tracking of the Full Scale Development Phase tasks. J.P.B.

N88-17724*# Boeing Aerospace Co., Seattle, Wash.
SYSTEM ANALYSIS STUDY OF SPACE PLATFORM AND STATION ACCOMMODATIONS FOR LIFE SCIENCES RESEARCH FACILITIES. VOLUME 2: STUDY RESULTS. APPENDIX D: LIFE SCIENCES RESEARCH FACILITY REQUIREMENTS Final Report
Lowell F. Wiley Oct. 1985 46 p
(Contract NAS8-35471)
(NASA-CR-179273; NAS 1.26:179273; D180-27863-2-Vol-2-App-D; DPD-614-Vol-2-App-D; DR-4-Vol-2-App-D) Avail: NTIS HC A03/MF A01 CSCL 22B

The purpose of this requirements document is to develop the foundation for concept development for the Life Sciences Research Facility (LSRF) on the Space Station. These requirements are developed from the perspective of a Space Station laboratory module outfitter. Science and mission requirements including those related to specimens are set forth. System requirements, including those for support, are detailed. Functional and design requirements are covered in the areas of structures, mechanisms, electrical power, thermal systems, data management system, life support, and habitability. Finally, interface requirements for the Command Module and Logistics Module are described. J.P.B.

N88-17725*# National Aeronautics and Space Administration, Washington, D.C.
AXAF: THE ADVANCED X-RAY ASTROPHYSICS FACILITY
[1988] 40 p Original contains color illustrations
(NASA-EP-251(M); NAS 1.19:251(M)) Avail: SOD HC $2.50 as 033-000-00904-6; NTIS MF A01 CSCL 22B

The Advanced X-ray Astrophysics Facility (AXAF) will be the X-ray astronomy component of U.S. space exploration via Great Observatories (mostly orbital) for the remainder of the century. AXAF and the research planned for it are discussed for a lay audience. J.P.B.

N88-17726# Lawrence Livermore National Lab., Calif.
MANEUVERABLE REENTRY VEHICLE TRAJECTORY FOOTPRINTS: CALCULATION AND PROPERTIES
F. A. Handler 20 Nov. 1987 37 p
(Contract W-7405-eng-48)
(DE88-004726; UCID-21286) Avail: NTIS HC A03/MF A01

We have obtained an analytical solution of MAneuverable Reentry Vehicle (MARV) trajectory equations that provides useful estimates of a MARV's potential impact footprint on the ground. We concentrate on quick footprint estimation, as required for battle management of a terminal strategic defense system, but we also present other applications such as evaluating tradeoffs between MARV trajectories, design capabilities, and resulting footprints. We estimate the footprint by analytically solving three types of maximal maneuvering trajectories in which the MARV combines maximal turns, lifts or dives through specified angles, finally attempting to extend level flight as long as possible. We display several quantitative results, for a range of MARV capabilities, including variation of footprint area with trajectory incidence angle, altitude, and lift capability. We find that footprint area decreases rapidly as altitude decreases due to the exponentially increasing atmospheric drag. Further, the eccentricity of the footprints depends sensitively on the altitude, incidence angle and velocity, ranging from 0.1 to 0.8. Footprint area increases as lift capability of the MARV increases, roughly as the 3/2 power of lift for a trajectory with incidence angle of 20 degrees. DOE

N88-17727*# National Academy of Sciences - National Research Council, Washington, D. C. Committee on the Space Station.
REPORT OF THE COMMITTEE ON THE SPACE STATION OF THE NATIONAL RESEARCH COUNCIL Final Report, May - Sep. 1987
Sep. 1987 50 p
(Contract NASw-3511)
(NASA-CR-181602; NAS 1.26:181602; PB88-126073) Avail: Committee on Space Station, National Research Council, 2101 Constitution Avenue N.W., Washington, D.C. 20418 HC free; NTIS MF A01 CSCL 22B

The Space Station Program will be the most ambitious space project the nation has ever undertaken; will require tens of billions of dollars; and will entwine for many years the space program with those of international partners. It must have enduring stable support across administrations, and the support must be generous. The current Space Shuttle is barely adequate for the limited purpose of deploying the Space Station, and it is inadequate to meet broader national needs in space. The Committee recommends in the strongest terms that the Shuttle be upgraded with new improved solid rocket motors, that it be supplemented with expendable launch vehicles, and that a heavy lift launch vehicle be developed for use in the latter half of the 1990s. The Committee strongly recommends that NASA prepare a new Space Station Program cost estimate in conjunction with the Program Requirements Review scheduled for early next year by NASA. The exercise should address the full range of uncertainties in the current Program, some of which are discussed in the report. GRA

N88-17728*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.
MAGNETIC EMISSIONS TESTING OF THE SPACE STATION ENGINEERING MODEL RESISTOJET
Daniel Briehl Feb. 1988 11 p
(NASA-TM-100788; E-3961; NAS 1.15:100788) Avail: NTIS HC A03/MF A01 CSCL 22B

The engineering model resistojet intended for altitude maintenance onboard the space station was tested for magnetic radiation emissions in the Radio Frequency Interference (RFI) facility at the Goddard Space Flight Center. The resistojet heater was supplied with power at 20 kHz and low voltage through a power controller. The resistojet was isolated from its power supply in the RFI enclosure, and the magnetic emission measured at three locations around the resistojet at various heater currents. At a heater current of 18.5 A the maximum magnetic emission was 61 dBpt at a distance of 1 m from the resistojet and at a location at the rear of the thruster. Calculations indicate that the case and heat shields provided a minimum of 4 dB of attenuation at a current of 18.5 A. Maximum radiation was measured at the rear of the resistojet along its major axis and was thought to be due to the magnetic radiation from the power leads. At a distance of 37 cm from the resistojet the maximum magnetic radiation measured was 73 dBpt at a current of 11.2 A. The power input leads were also a source of magnetic radiation. The engineering model rssistojet requires about 20 dB of additional shielding. Author

N88-17729# Naval Postgraduate School, Monterey, Calif.
PRELIMINARY DESIGN OF THE ORION ATTITUDE CONTROL SYSTEM M.S. Thesis
David C. Chappell Dec. 1987 100 p
(AD-A187179) Avail: NTIS HC A05/MF A01 CSCL 22B

This thesis models the motion of the NPS satellite ORION using the three Euler rotation angles. The simulation program also models aerodynamic drag and gravity gradient torques. Simulations are performed to analyze the effect of changing the inertia ratio on satellite stability and performance. The active nutation control method was also simulated and an example of its operation given. The amount of time required to reduce nutation to an acceptable level was found to be dependent on the initial nutation angle, spin rate, and thruster size. The slower the spin rate, the greater the torque that could be used during a given firing arc resulting in faster nutation control. GRA

N88-17730# National Aerospace Lab., Tokyo (Japan).
FORMULATION METHODS OF RIGID MULTIBODY SYSTEMS FOR LARGE SPACE STRUCTURES AND SOME RESULTS OF COMPUTER SIMULATION
Yoshiaki Ohkami, Osamu Okamoto, Takashi Kida, Isao Yamaguchi, Katsuhiko Yamada, and Kazuo Tsuchiya Aug. 1987 19 p In JAPANESE; ENGLISH summary
(NAL-TR-942; ISSN-0389-4010) Avail: NTIS HC A03/MF A01

A comparative study of the simulation algorithms for dynamics of large space structures modeled as a collection of rigid multibodies connected by hinges is described. Two algorithms have been independently developed at two research institutes. One method is based upon the well-known Euler Newton formulation and the unified matrix approach. The unified matrix approach solves the dynamical equation for the derivatives of the non-holonomic velocities and the internal torques and forces simultaneously, hence permitting us to deal with an arbitrary large space structure (LSS) configuration. The other method provides for an efficient and fast algorithm based on Kane's method with modification in the inertia dyadic and other quantities. Both methods have been applied to two typical examples: the first is a satellite with four-link manipulator as a model of a chain structure, and the second is a satellite with a closed loop deployment mechanism. The results coincide satisfactorily and the validity of the two methods has been proven perfectly. The numerical values given in this report will be useful as a reference in other simulations. Author

N88-17711*# Federal Aviation Administration, Washington, D.C.
LIGHTSATS AND THEIR ATTRACTION TO BUDGET ORIENTED FEDERAL AGENCIES
Charles A. Bonsall *In* NASA. Goddard Space Flight Center, The 1987 Get Away Special Experimenter's Symposium Feb. 1988 p 141-146 (For primary document see N88-17691 10-12)
Avail: NTIS HC A08/MF A01 CSCL 22B

N88-17827# Messerschmitt-Boelkow-Blohm G.m.b.H., Ottobrunn (West Germany). Unternehmensbereich Raumfahrt.
AZUR, THE FIRST GERMAN RESEARCH SATELLITE 625-A, 1964-1969 [AZUR - ERSTER DEUTSCHER FORSCHUNGS-SATELLIT 625-A, 1964-1969]
Ernst Theunissen and Hans Fabian *In its* Research and Development. Technical-Scientific Publications (1956-1987): Retrospective View and Prospects. Jubilee Edition on the Occasion of the 75th Anniversary of Dipl.-Engr. Dr.-Engr. E.H. Ludwig Boelkow 1987 p 65-70 In GERMAN (For primary document see N88-17819 10-31)
Copyright Avail: NTIS HC A14/MF A01

19 SPACECRAFT INSTRUMENTATION

For related information see also *06 Aircraft Instrumentation* and *35 Instrumentation and Photography.*

No abstracts in this category.

20 SPACECRAFT PROPULSION AND POWER

Includes main propulsion systems and components, e.g., rocket engines; and spacecraft auxilliary power sources.

For related information see also *07 Aircraft Propulsion and Power, 28 Propellants and Fuels, 44 Energy Production and Conversion,* and *15 Launch Vehicles and Space Vehicles.*

N88-17731*# Sverdrup Technology, Inc., Cleveland, Ohio.
COMPONENT DATA BASE FOR SPACE STATION RESISTOJET AUXILIARY PROPULSION Final Report
Clayton H. Bader Jan. 1988 62 p Microfiche included as supplement
(Contract NAS3-24105)
(NASA-CR-180834; E-3856; NAS 1.26:180834) Avail: NTIS HC A04/MF A01 CSCL 21H

The resistojet was baselined for Space Station auxiliary propulsion because of its operational versatility, efficiency, and durability. This report was conceived as a guide to designers and planners of the Space Station auxiliary propulsion system. It is directed to the low thrust resistojet concept, though it should have application to other station concepts or systems such as the Environmental Control and Life Support System (ECLSS), Manufacturing and Technology Laboratory (MTL), and the Waste Fluid Management System (WFMS). The information will likely be quite useful in the same capacity for other non-Space Station systems including satellite, freeflyers, explorers, and maneuvering vehicles. The report is a catalog of the most useful information for the most significant feed system components and is organized for the greatest convenience of the user. Author

N88-17732*# Aerojet TechSystems Co., Sacramento, Calif.
ARCJET THRUSTER RESEARCH AND TECHNOLOGY Final Report
Darby B. Makel and Gordon L. Cann (Technion, Inc., Irvine, Calif.) Feb. 1988 300 p
(Contract NAS3-24842)
(NASA-CR-180865; NAS 1.26:180865; RPT/BB0642) Avail: NTIS HC A13/MF A01 CSCL 21H

The design, analysis, and performance testing of an advanced lower power arcjet is described. A high impedance, vortex stabilized 1-kw class arcjet has been studied. A baseline research thruster has been built and endurance and performance tested. This advanced arcjet has demonstrated long lifetime characteristics, but lower than expected performance. Analysis of the specific design has identified modifications which should improve performance and maintain the long life time shown by the arcjet. Author

N88-17733*# Alabama Univ., Huntsville. Dept. of Mechanical Engineering.
SHUTTLE ROCKET BOOSTER COMPUTATIONAL FLUID DYNAMICS Final Report
T. J. Chung and O. Y. Park 1988 108 p
(Grant NAG8-629)
(NASA-CR-182518; NAS 1.26:182518) Avail: NTIS HC A06/MF A01 CSCL 21H

Additional results and a revised and improved computer program listing from the shuttle rocket booster computational fluid dynamics formulations are presented. Numerical calculations for the flame zone of solid propellants are carried out using the Galerkin finite elements, with perturbations expanded to the zeroth, first, and second orders. The results indicate that amplification of oscillatory motions does indeed prevail in high frequency regions. For the second order system, the trend is similar to the first order system for low frequencies, but instabilities may appear at frequencies lower than those of the first order system. The most significant effect of the second order system is that the admittance is extremely oscillatory between moderately high frequency ranges. Author

N88-17826# Bolkow Entwicklungen K. G., Munich (West Germany). Entwicklungsfachabteilung Triebwerke.
ROCKET AND AIRJET PROPULSION FOR BALLISTIC AND AERODYNAMIC SPACE PROBES [RAKETEN- UND LUFTSTRAHLANTRIEBE FUER BALLISTISCHE UND AERODYNAMISCHE RAUMFLUGKOERPER]
Karl Stoeckel *In* MBB GmbH, Research and Development. Technical-Scientific Publications (1956-1987): Retrospective View and Prospects. Jubilee Edition on the Occasion of the 75th Anniversary of Dipl.-Engr. Dr.-Engr. E.H. Ludwig Boelkow 1987 p 59-64 In GERMAN Presented at the WGLR/DGRR-Jahrestagung, Berlin, Fed. Republic of Germany, 14-18 Sep. 1964 (For primary document see N88-17819 10-31) (Rept-TR-527) Copyright Avail: NTIS HC A14/MF A01

23 CHEMISTRY AND MATERIALS (GENERAL)

No abstracts in this category.

24 COMPOSITE MATERIALS

Includes physical, chemical, and mechanical properties of laminates and other composite materials.
For ceramic materials see *27 Nonmetallic Materials*.

N88-17734# Plastics and Rubber Inst., London (England).
AUTOMATED COMPOSITES, FIRST INTERNATIONAL CONFERENCE, SEPTEMBER 10-12, 1986, UNIVERSITY OF NOTTINGHAM, ENGLAND
1986 240 p Conference held in Nottingham, United Kingdom, 10-12 Sep. 1986
(PB87-126199) Avail: NTIS HC E11/MF E11 CSCL 11D

Topics include: Robotically controlled water jet cutters in aerospace; a flexible manufacturing system for high performance FRP components; ultrasonic cutting process for aerospace pre-preg materials; automated fiber orientation for advanced composites; a sideguard system for commercial vehicles using pultruded composite beams; computer aided design and manufacture of filament wound composite structures; microcomputer based cost estimation of filament winding; integrated modwind systems; software for filament winding; innovations in automated tape lay-up equipment; control system for filament winding equipment; automated ply lamination; centrifugally cast GRP pipes; tape laying techniques for production of an advanced helicopter rotor spar; combination of CAD with CAM of filament wound pressure vessels and pipes; industrial robots for manufacture of high performance aircraft nose radomes; pulforming, a continuous process for mass producing composite articles; robotic ultrasonic scanning system; joining thermoplastics composites; robots applied to the NDT inspection; and pole repair systems incorporating cost effective pultruded sections. GRA

N88-17735# Aeronautical Research Labs., Melbourne (Australia).
EFFECT OF POST-CURE HEAT-TREATMENT ON STATIC AND FATIGUE BEHAVIOUR OF XAS-914C CARBON FIBRE COMPOSITE
T. J. VanBlaricum and G. Clark 17 Aug. 1987 18 p
(AD-A186943; ARL-STRUC-TM-470; DODA-AR-004-555) Avail: NTIS HC A03/MF A01 CSCL 11D

XAS-914C carbon fiber composite requires a post cure heat treatment cycle to complete polymer cross linking in the epoxy matrix material. The effect of omitting the post cure cycle on the fatigue performance of 56 ply laminate containing impact damage and on the static compressive strength of the same laminate was investigated. GRA

N88-17736# Atomic Energy Research Establishment, Harwell (England). Materials Development Div.
FABRICATION AND MATERIALS EVALUATION OF HIGH PERFORMANCE ALIGNED CERAMIC FIBRE REINFORCED GLASS MATRIX COMPOSITE
D. M. Dawson, R. F. Preston, and A. Purser Nov. 1986 19 p Sponsored in part by the Department of Trade and Industry, United Kingdom
(AERE-R-12517; HL87/1017) Avail: NTIS HC A03/MF A01

Techniques were developed to fabricate aligned, continuous SiC fiber reinforced Pyrex composites. The processing route followed was the formation of the pre-preg sheet by slurry impregnation and filament winding of continuous fiber tows and subsequent consolidation by hot pressing. The high strength and toughness resulting from this process was retained up to 500 C, above which the matrix began to soften and composite deformation occurred. At 500 C the creep rate, with applied stress of 300 MPa, was 2 x 10 (-7) h (-1). Specimens survived loading to 500 MPa for 1000 hours at 500 C in air. Subsequent testing to failure at room temperature indicated that no significant degradation had occurred. Author

N88-17737*# National Aeronautics and Space Administration. Langley Research Center, Hampton, Va.
A FIBER-RESIN MICROMECHANICS ANALYSIS OF THE DELAMINATION FRONT IN A DCB SPECIMEN
J. H. Crews, K. N. Shivakumar, and I. S. Raju (Analytical Services and Materials, Inc., Hampton, Va.) Jan. 1988 43 p
(NASA-TM-100540; NAS 1.15:100540) Avail: NTIS HC A03/MF A01 CSCL 11D

A 3-D finite element model was developed to analyze the fiber-resin behavior near the delamination front in a graphite-epoxy double cantilever beam (DCB) specimen. The specimen interior was analyzed using a typical one-fiber slice, represented by a local 3-D fiber-resin model. The resin stresses were computed for the resin-rich layer at the ply interface as well as for the regions between the fibers close to the delamination front. However, the computed strain energy release rate G sub I along the delamination front varied by less than two percent, and was within about four percent of the plane-strain value. The von Mises yield criterion was used to estimate the extent of yielding near the delamination front. The yielding extended ahead of the delamination and also developed between the fibers. Although the fibers had only a negligible effect on G sub I, they caused yielding within the ply and therefore could influence delamination fracture toughness. The normal and shear stresses at the fiber-resin interface were computed near the delamination front. These results suggest that multi-axial stress criteria may be required to analyze fiber-resin interfaces. Author

N88-17738*# Virginia Polytechnic Inst. and State Univ., Blacksburg. Coll. of Engineering.
COMPOSITE MATERIALS FOR RAIL TRANSIT SYSTEMS Final Technical Report
O. Hayden Griffin, Jr., Zafer Guerdal, and Carl T. Herakovich Dec. 1987 34 p
(Grant NAG1-673)
(NASA-CR-178401; NAS 1.26:178401) Avail: NTIS HC A03/MF A01 CSCL 11D

The potential is explored for using composite materials in urban mass transit systems. The emphasis was to identify specific advantages of composite materials in order to determine their actual and potential usage for carbody and guideway structure applications. The literature was reviewed, contacts were made with major domestic system operators, designers, and builders, and an analysis was made of potential composite application to railcar construction. Composites were found to be in use throughout the transit industry, usually in secondary or auxiliary applications such as car interior and nonstructural exterior panels. More recently, considerable activity has been initiated in the area of using

composites in the load bearing elements of civil engineering structures such as highway bridges. It is believed that new and improved manufacturing refinements in pultrusion and filament winding will permit the production of beam sections which can be used in guideway structures. The inherent corrosion resistance and low maintenance characteristics of composites should result in lowered maintenance costs over a prolonged life of the structure. Author

N88-17739*# National Aeronautics and Space Administration. Langley Research Center, Hampton, Va.
AN ANALYTICAL STUDY OF THE EFFECTS OF TRANSVERSE SHEAR DEFORMATION AND ANISOTROPY ON NATURAL VIBRATION FREQUENCIES OF LAMINATED CYLINDERS
Dawn C. Jegley Jan. 1988 36 p
(NASA-TM-100554; NAS 1.15:100554) Avail: NTIS HC A03/MF A01 CSCL 11D

Natural vibration frequencies of orthotropic and anisotropic simply supported right circular cylinders are predicted using a higher-order transverse-shear deformation theory. A comparison of natural vibration frequencies predicted by first-order transverse-shear deformation theory and the higher-order theory shows that an additional allowance for transverse shear deformation has a negligible effect on the lowest predicted natural vibration frequencies of laminated cylinders but significantly reduces the higher natural vibration frequencies. A parametric study of the effects of ply orientation on the natural vibration frequencies of laminated cylinders indicates that while stacking sequence affects natural vibration frequencies, cylinder geometry is more important in predicting transverse-shear deformation effects. Interaction curves for cylinders subjected to axial compressive loadings and low natural vibration frequencies indicate that transverse shearing effects are less important in predicting low natural vibration frequencies than in predicting axial compressive buckling loads. The effects of anisotropy are more important than the effects of transverse shear deformation for most strongly anisotropic laminated cylinders in predicting natural vibration frequencies. However, transverse-shear deformation effects are important in predicting high natural vibration frequencies of thick-walled laminated cylinders. Neglecting either anisotropic effects or transverse-shear deformation effects leads to non-conservative errors in predicted natural vibration frequencies. Author

N88-17740# Foersvarets Forskingsanstalt, Stockholm (Sweden).
EFFECTS OF AVIATION FLUIDS ON CARBON FIBRE COMPOSITE MATERIAL
E. Halloff and B. Holmberg Sep. 1987 18 p In SWEDISH; ENGLISH summary
(PB88-127857; FOA-C-20674-2.6) Avail: NTIS HC A03/MF A01 CSCL 11D

Unloaded specimens of carbon fiber composite materials have been exposed to ten aviation fluids, that is, oils, fuels, hydraulic fluids, antiicing fluids, cooling fluids and fireretarding agents at room temperature and in some cases at elevated temperatures. The effect was determined in terms of changes of the mechanical properties of the exposed specimens. GRA

N88-17741# Foersvarets Forskingsanstalt, Stockholm (Sweden).
EFFECT OF THERMAL SHOCK ON CARBON FIBER/EPOXY COMPOSITES
B. Holmberg Sep. 1987 19 p In SWEDISH; ENGLISH summary
(PB88-128228; FOA-C-20675-2.6) Avail: NTIS HC A03/MF A01 CSCL 11D

The effect of thermal shock on the carbon fiber/epoxy-composite material Fibredux 914C/T300 (Ciba-Geigy) has been studied. The material has been cycled between 110 C and -60 C after different pretreatments. Changes in the strength properties have been related to the moisture content from determinations of tensile strength and elasticity modulus. GRA

N88-17742# Missouri Univ., Rolla.
SHORT FIBER REINFORCED THERMOPLASTIC COMPOSITES FOR ARMOR APPLICATIONS: INTERFACIAL BONDING Preliminary Final Report, 1 Jun. - 1 Nov. 1987
D. E. Day and M. N. Rahaman 20 Nov. 1987 13 p
(Contract W-7405-eng-36)
(DE88-004007; LA-SUB-H2050E-1) Avail: NTIS HC A03/MF A01

The interfacial bond strength between high strength glass fibers and poly(methyl methacrylate) was measured by incorporating individual, continuous fibers in tensile samples of the polymer. When the fibers were coated with a silane coupling agent, the measured bond strength (20 MPa) was twice the value (10 MPa) obtained for the samples without coupling agent. Bonding between the same fibers and polycarbonate was examined using scanning electron microscopy. Fibers coated with an amino-silane coupling agent showed considerably better bonding to the polymer compared with the uncoated fibers. Work in progress involves optimization of the bonding in polycarbonate, and an examination of the bonding between the same fibers and polyacetal. DOE

N88-17743*# National Aeronautics and Space Administration. Ames Research Center, Moffett Field, Calif.
HIGH-TEMPERATURE PROPERTIES OF CERAMIC FIBERS AND INSULATIONS FOR THERMAL PROTECTION OF ATMOSPHERIC ENTRY AND HYPERSONIC CRUISE VEHICLES
Demetrius A. Kourtides, William C. Pitts, Myrian Araujo, and R. S. Zimmerman (Wyoming Univ., Laramie.) Feb. 1988 18 p
(NASA-TM-100059; A-88059; NAS 1.15:100059) Avail: NTIS HC A03/MF A01 CSCL 11D

Multilayer insulations (MIs) which will operate in the 500 to 1000 C temperature range are being considered for possible applications on aerospace vehicles subject to convective and radiative heating during atmospheric entry. The insulations described consist of ceramic fibers, insulations, and metal foils quilted together with ceramic thread. As these types of insulations have highly anisotropic properties, the total heat transfer characteristics must be determined. Data are presented on the thermal diffusivity and thermal conductivity of four types of MIs and are compared to the baseline Advanced Flexible Reusable Surface Insulation currently used on the Space Shuttle Orbiter. In addition, the high temperature properties of the fibers used in these MIs are discussed. The fibers investigated included silica and three types of aluminoborosilicate (ABS). Static tension tests were performed at temperatures up to 1200 C and the ultimate strain, tensile strength, and tensile modulus of single fibers were determined. Author

N88-17744*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.
MECHANICS OF COMPOSITE MATERIALS: PAST, PRESENT AND FUTURE
Christos C. Chamis [1988] 41 p Presented at the 21st Annual Meeting of the Society for Engineering Science, Blacksburg, Va., 15-17 Oct. 1984
(NASA-TM-100793; E-3936; NAS 1.15:100793) Avail: NTIS HC A03/MF A01 CSCL 11D

Composite mechanics disciplines are presented and described at their various levels of sophistication and attendant scales of application. Correlation with experimental data is used as the prime discriminator between alternative methods and level of sophistication. Major emphasis is placed on: (1) where composite mechanics has been; (2) what it has accomplished; (3) where it is headed, based on present research activities; and (4) at the risk of being presumptuous, where it should be headed. The discussion is developed using selected, but typical examples of each composite mechanics discipline identifying degree of success, with respect to correlation with experimental data, and problems remaining. The discussion is centered about fiber/resin composites drawn mainly from the author's research activities/experience spanning two decades at Lewis. Author

N88-17745*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.
FINITE ELEMENT SUBSTRUCTURING METHODS FOR COMPOSITE MECHANICS
Pappu L. N. Murthy (Cleveland State Univ., Ohio.) and Christos C. Chamis 1988 17 p Presented at the International Conference on Composite Materials and Structures, Madras, India, 6-9 Jan. 1988; sponsored by India Inst. of Technology
(NASA-TM-100297; E-3946; NAS 1.15:100297) Avail: NTIS HC A03/MF A01 CSCL 11D

Finite element substructuring strategies are presented to obtain numerical solutions for three typical problems of interest to the composites community: (1) impact and toughness characterization of composites using Charpy's impact test specimen; (2) free-edge stress analysis of composite laminates; and (3) fracture toughness predictions of composites for individual and combined fracture of modes I, II, and III. The key issue common to these problems is the presence of singular or near singular stress fields. The regions prone to see steep stress gradients are substructured with progressively refined meshes to study the local response simultaneously with the global response. The results from the select examples indicate that finite element substructuring methods are computationally effective for composite singularity mechanics. J.P.B.

N88-17746# Rensselaer Polytechnic Inst., Troy, N.Y. Dept. of Civil Engineering.
ANALYTICAL AND EXPERIMENTAL CHARACTERIZATION OF DAMAGE PROCESSES IN COMPOSITE LAMINATES Annual Progress Report, Jun. 1986 - Jul. 1987
George J. Dvorak and Norman Laws Jul. 1987 36 p
(Grant AF-AFOSR-0366-84)
(AD-A187221; AFOSR-87-1451TR) Avail: NTIS HC A03/MF A01 CSCL 11D

This report presents a brief summary of results obtained in our research program on damage development in fibrous composite laminates. The following technical subjects are described: (1) effect of fiber breaks on stiffness changes in unidirectional composites; (2) stress analysis of transverse cracks; (3) progressive transverse cracking of 0/90 laminates; (4) analysis of cracks approaching a boundary between two materials; and (5) fatigue of B/Al laminates. GRA

N88-17747# Virginia Polytechnic Inst. and State Univ., Blacksburg. Center for Adhesion Science.
A FINITE ELEMENT ANALYSIS OF ADHESIVELY BONDED COMPOSITE JOINTS INCLUDING GEOMETRIC NONLINEARITY, NONLINEAR VISCOELASTICITY MOISTURE DIFFUSION AND DELAYED FAILURE Interim Report
S. Roy and J. N. Reddy Oct. 1987 92 p
(Contract N00014-82-K-0185)
(AD-A187455; CAS/ESM-87-9; VPI-E-87-21) Avail: NTIS HC A05/MF A01 CSCL 13E

A two-dimensional finite-element computational procedure is developed for an analysis of adhesively bonded joints with nonlinear viscoelasticity, moisture diffusion and delayed failure models. Effect of temperature and stress level on the viscoelastic response is taken into account by a nonlinear shift factor definition, and penetrant sorption is accounted via a nonlinear Fickean diffusion model in which the diffusion coefficient is dependent on the penetrant concentration and dilatational strain. A delayed failure criterion based on the Reiner-Weisenberg failure theory is also included. Several example problems are: adhesive joints, bonded joints, finite element analysis, composite joints, moisture diffusion, delayed failure, nonlinear viscoelasticity, numerical results. GRA

N88-17748# Virginia Polytechnic Inst. and State Univ., Blacksburg. Dept. of Engineering Science and Mechanics.
THE MAGIC OF CARRIER PATTERNS IN MOIRE INTERFEROMETRY
Y. Guo, D. Post, and R. Czarnek Aug. 1987 7 p
(Contract N00014-86-K-0255)
(AD-A187582) Avail: NTIS HC A02/MF A01 CSCL 11D

Practical applications in which carrier patterns are used with moire interferometry for strain measurements are presented. Examples of typical experimental analyses illustrate how moire carrier patterns are applied to obtain the desired data in complex laminated composite specimens. In many cases, carrier patterns permit extraction of much more detailed information, with procedures that are easier and more accurate than those using load-induced fringes alone. In moire interferometry, the carrier patterns can be introduced easily by adjustments of optical elements that control the virtual reference grating. GRA

N88-17749# Grumman Aerospace Corp., Bethpage, N.Y. Corporate Research Center.
MICRO-MECHANISMS OF DEFORMATION IN SiC/Al COMPOSITES Final Report, 1 Aug. 1984 - 31 Aug. 1987
John M. Papazian, Alvin Levy, and Philip N. Adler 31 Aug. 1987 37 p
(Contract F49620-84-C-0055)
(AD-A188282; RE-738; AFOSR-87-1658TR) Avail: NTIS HC A03/MF A01 CSCL 11F

The deformation mechanisms of aluminum matrix composites containing SiC whiskers or particulate were investigated both experimentally and analytically to determine factors critical to their mechanical behavior. The effects of the discontinuous SiC on age-hardening behavior; the influence of silicon carbide morphology; interactions between SiC dispersoids and matrix precipitates, and dislocations were considered. Two matrix alloys were investigated: a solution-hardened 5456 alloy containing no matrix precipitates; and a 2124 alloy that could be aged and cold worked to contain different matrix precipitate microstructures and dislocation contents. The influence of SiC on the age-hardening behavior of 2124 was evaluated using differential scanning calorimetry. The precipitation sequence in the composites was found to be very similar to that in SiC-free material prepared by either powder or ingot metallurgy. Both whiskers and particulate increased the quench sensitivity of 2124 by causing the precipitation of GPB zones and S' during the quench from solution heat treatment. This effect was independent of quench rate. GRA

25 INORGANIC AND PHYSICAL CHEMISTRY

Includes chemical analysis, e.g., chromatography; combustion theory; electrochemistry; and photochemistry.

For related information see also *77 Thermodynamics and Statistical Physics.*.

N88-17750# Argonne National Lab., Ill.
APPLICATION OF INVERSE GAS CHROMATOGRAPHY TO FLUIDITY STUDIES
R. E. Winans and P. H. Neill 1987 12 p Presented at the 2nd Coal Research Conference, Wellington, New Zealand, 2 Nov. 1987
(Contract W-31-109-eng-38)
(DE88-002896; CONF-871193-1) Avail: NTIS HC A03/MF A01

We have developed a new method, Inverse Gas Chromatography (IGC), for evaluating coal fluidity at elevated temperatures. This technique is being used to follow changes in coal structure which affect the coal's fluidity. In IGC, which is used to study polymers, the retention of a probe molecule on the coal surface in a flowing gas system is followed as a function of temperature. The relative size of changes in the structure and the temperatures at which these changes occur can be measured very accurately with this technique. The results compare favorably with more traditional methods of measuring coal fluidity while, in addition, providing data which can be used to understand the underlying chemical and physical changes in structure with weathering. DOE

N88-17751# Argonne National Lab., Ill.
GAS PHASE PULSE RADIOLYSIS
C. D. Jonah, Liu Andong, and W. A. Mulac 1987 7 p Presented

at the 8th International Congress of Radiation Research, Edinburgh, United Kingdom, 19 Jul. 1987
(Contract W-31-109-eng-38)
(DE88-002981; CONF-870701-13) Avail: NTIS HC A02/MF A01

Gas phase pulse radiolysis, a technique which can be used to study many different phenomena in chemistry and physics, is discussed. As a source of small radicals, pulse radiolysis is important to the field of chemistry, particularly to combustion and atmospheric kinetics. The reactions of 1,3-butadiene, allene, ethylene and acetylene with OH are presented. DOE

N88-17752# Argonne National Lab., Ill.
MATERIALS DEVELOPMENT FOR JPL OXYGEN PLANT
T. E. Easler and R. B. Poeppel Jun. 1987 11 p Presented at the 7th Annual Gasification Systems Conference, Morgantown, West Virginia, 16 Jun. 1987
(Contract W-31-109-eng-38)
(DE88-003067; CONF-870659-6) Avail: NTIS HC A03/MF A01

The purpose of this research program is to establish the durability of thin electrolyte layers so that minimum component thicknesses may be used in a solid oxide oxygen pump as the means of reducing internal power losses, while still maintaining the required mechanical integrity of the structure. The internal power losses are directly proportional to the product of the thickness and resistivity of the individual component material and inversely proportional to the active area. The reduction of these losses is desirable in order to enhance the solid oxide oxygen pump economics relative to conventional pumping techniques. Previous and current work in the scientific and industrial communities has proven the feasibility of fabricating thin-section ceramic components by techniques such as tape casting. Proof-of-concept work has also been carried out illustrating that thin ceramic sections can be successfully bonded together as anode/electrolyte/cathode units for fuel cells. Although this technology has been developing rapidly, there is a lack of information on the ability of these structures to survive the stress and/or strains imposed by the assembly configuration and operating conditions. DOE

N88-17753# Atomic Energy Research Establishment, Harwell (England). Materials Physics and Metallurgy Div.
THE MEASUREMENT OF CHEMICAL COMPOSITON WITH HIGH SPATIAL RESOLUTION USING A DEDICATED SCANNING TRANSMISSION ELECTRON MICROSCOPE
J. M. Titchmarsh, C. M. Shepherd, and I. A. Vatter Feb. 1987 38 p
(AERE-R-12317; HL87/1055) Avail: NTIS HC A03/MF A01

The principal features of the recently installed VG HB501 dedicated scanning transmission electron microscope are described. The instrument has a high brightness electron source capable of producing a focused probe with a typical diameter of approximately 1 nm. Chemical composition on this scale is obtained by measuring the X-ray signals excited in a thin specimen, using the energy dispersive method. Examples are given which illustrate the performance of the instrument for examination of metals, semiconductors and catalysts. Author

N88-17754# Atomic Energy Research Establishment, Harwell (England). Materials Development Div.
HIGH RESOLUTION ELECTRON AND ION MICROSCOPY
B. A. Bellamy, ed. Jan. 1987 29 p Proceedings of the UKAEA Conference on Materials Analysis by Physical Techniques, United Kingdom, 11-13 Nov. 1986
(AERE-R-12502; HL87/1021) Avail: NTIS HC A03/MF A01

Papers presented at the conference cover the application of high resolution electron and ion microscopical techniques to the study of materials. Invited papers were also presented on scanning tunnelling microscopy, X-ray diffraction techniques, laser based techniques, autoradiography and atomic absorption spectrophotometry. Author

N88-17755# Argonne National Lab., Ill. Theoretical Chemistry Group.
INSIGHTS INTO THE MECHANISMS OF CHEMICAL REACTIONS: REACTION PATHS FOR CHEMICAL REACTIONS
T. H. Dunning, Jr., E. Rosen, and R. A. Eades 1987 28 p Presented at the Faraday Discussion on Dynamics of Elementary Gas Phase Reactions, Birmingham, United Kingdom, 14 Sep. 1987
(Contract W-31109-eng-38)
(DE88-003041; CONF-8709113-3) Avail: NTIS HC A03/MF A01

We report reaction paths for two prototypical chemical reactions: Li + HF, an electron transfer reaction, and OH + H2, an abstraction reaction. In the first reaction we consider the connection between the energetic terms in the reaction path Hamiltonian and the electronic changes which occur upon reaction. In the second reaction we consider the treatment of vibrational effects in chemical reactions in the reaction path formalism. DOE

N88-17756# Gosudarstvennyi Komitet po Ispolzovaniyu Atomnoi Energii, Moscow (USSR). Inst. Teoreticheskoj i Ekhsperimental'noj Fiziki.
FLAME PROPAGATION IN THE APPROXIMATION OF STRAIGHT-LINE TRAJECTORIES OF BURNING PRODUCTS
M. M. Basko and A. B. Budko 1986 18 p In RUSSIAN
(DE88-700675; ITEF-27(1986)) Avail: NTIS (US Sales Only) HC A03/MF A01

Equations are derived which describe the propagation of subsonic burning waves due to the finite straight-line range of fast reaction products. A detailed analysis of the flame propagation is performed for a step-like temperature dependence of the burning reaction rate. The numerically calculated values of the normal flame velocity for deuterium-tritium mixture are also presented. DOE

N88-17757# Gosudarstvennyi Komitet po Ispolzovaniyu Atomnoi Energii, Moscow (USSR). Inst. Teoreticheskoj i Ehksperimental'noj Fiziki.
DIFFUSION DESCRIPTION OF FLAME PROPAGATION DUE TO THE TRANSLATIONAL MOTION OF BURNING REACTION PRODUCTS
M. M. Basko and A. B. Budko 1986 20 p In RUSSIAN
(DE88-700676; ITEF-28(1986)) Avail: NTIS (US Sales Only) HC A03/MF A01

Equations are derived which describe the propagation of subsonic burning waves due to the straight-line motion of fast particles (the products of burning reaction) in two approximations - the diffusion approximation and the so called alpha-conductivity approximation. The values of the normal flame velocity are calculated for step-like as well as for a real (corresponding to the fusion reaction of the deuterium-tritium mixture) burning functions. The diffusion approximation is shown to be in a close agreement with the solutions of the rigorous kinetic equation and to require no flux limit. DOE

N88-17758# Dayton Univ., Ohio.
CHARACTERIZATION OF THE ARC/SPARK EXCITATION SOURCES USED IN THE SPECTROMETRIC OIL ANALYSIS PROGRAM Final Report, 14 Sep. 1984 - 14 Nov. 1985
Robert E. Kauffman and Wendell E. Rhine 5 Oct. 1987 203 p
(Contract N68335-84-C-1664; Proj. F41-460)
(AD-A187131; UDR-TR-85-146; NAEC-92-191) Avail: NTIS HC A10/MF A01

A program is being conducted to improve the particle detection capability of the rotating disk electrode arc/spark source atomic emission spectrometer, i.e., the A/E35U-3. This spectrometer is the primary spectrometer used by over 200 of the tri-service Joint Oil Analysis Program (JOAP) Laboratories. Specifically, the A/E35U-3 emission spectrometer is used by 82 percent of the Air Force, 96 percent of the Navy, and 100 percent of the Army JOAP laboratories. The initial investigation determined the factors which limit the particle detection capability of the A/E35U-3 spectrometers. The results of this investigation were delineated in

NAEC-92-169, Spectrometer Sensitivity Investigations on the Spectrometric Oil Analysis Program. GRA

N88-17759# Battelle Pacific Northwest Labs., Richland, Wash.
SUPERCRITICAL FLUID EXTRACTION-GAS CHROMATOGRAPHY OF VOLATILE ORGANIC COMPOUNDS (VOC) FROM TENAX DEVICES Final Report, Nov. 1985 - Sep. 1986

B. W. Wright, A. J. Kopriva, and R. D. Smith Nov. 1987 80 p
(Contract EPA-68-02-4127)
(PB88-124300; Rept-2311107118; EPA/600/4-87/033) Avail: NTIS HC A05/MF A01 CSCL 07C

The development and evaluation of on-line supercritical fluid extraction-gas chromatography instrumentation and methodology for the analysis of volatile organic compounds (VOC) from absorbent sampling devices are described. Supercritical fluid extraction offers potential advantages for the removal and transport of organic components from adsorbent matrices including rapid and efficient extraction at mild temperatures. Extraction at mild temperatures eliminates potential problems such as analyte decomposition that can be encountered with the high temperatures needed for thermal desorption analysis. Since a major objective of the study was to develop viable instrumentation and methodology, a relatively detailed description of the instrumentation design requirements and present limitations are discussed. The results of several series of methodology validation studies are also presented. These studies included recovery studies of model VOC spiked on three types of Tenax sampling devices including authenic actively pumped (VOST) and passive (EPA) devices. Replicate devices spiked in an exposure chamber were also subjected to parallel analyses using the new methodology and traditional thermal desorption gas chromatography. GRA

N88-17760# Brown Univ., Providence, R. I.
LOW TEMPERATURE REACTIVITY OF CHARS TOWARDS OXYGEN, APPENDIX E2

M. Wojtowicz, J. Calo, W. Lilly, and E. Suuberg 1987 6 p Presented at the 18th Biennial Carbon Conference, Worcester, Mass., 19 Jul. 1987
(Contract DE-FG22-83PC-60800)
(DE88-004088; CONF-870796-3-App-E2) Avail: NTIS HC A02/MF A01

For only the very low burnoff chars is there observed unusually low reactivity, even when corrected for surface area. Thus, the similarities of the different materials are again noted, when compared at the same burnoff. From these and other data, we are developing a picture of low temperature char gasification that involves the following steps: (1) sorption of oxygen onto active sites; (2) reaction of oxygen with surface oxides to release oxides of carbon; and (3) thermal decomposition of surface oxides to release oxides of carbon. Separately, we are developing a model of char annealing during heat treatment. The degree to which process 3 competes with process 2 seems to be a function of the nature of the char. Proper accounting for reactions of type 3 is important in sorting out reaction order, especially at low oxygen partial pressures. We have observed an overall apparent order of reaction of O sub 2 with char in the temperature range 573 to 673 K of roughly 0.7 to 0.8. This is, again, not a function of extent of heat treatment of the char, although the overall reactivity varies by more than an order of magnitude from the low temperature to the high temperature chars. The apparent activation energies for the annealing process are presented. DOE

N88-17761*# National Academy of Sciences - National Research Council, Washington, D. C.
EARTH MATERIALS RESEARCH: REPORT OF A WORKSHOP ON PHYSICS AND CHEMISTRY OF EARTH MATERIALS

[1987] 134 p Sponsored in part by DOE, Washington, D.C. and by Geological Survey, Reston, Va.
(Contract DE-FG01-82ER-12018; Grants DI-14-08-0001-G-1124; NSF EAR-85-18789)
(NASA-CR-182519; NAS 1.26:182519; PB88-131594) Avail: NTIS HC A07/MF A01 CSCL 07D

The report concludes that an enhanced effort of earth materials research is necessary to advance the understanding of the processes that shape the planet. In support of such an effort, there are new classes of experiments, new levels of analytical sensitivity and precision, and new levels of theory that are now applicable in understanding the physical and chemical properties of geological materials. The application of these capabilities, involves the need to upgrade and make greater use of existing facilities as well as the development of new techniques. A concomitant need is for a sample program involving their collection, synthesis, distribution, and analysis. GRA

N88-17762# Department of Energy, Morgantown, W. Va. Energy Technology Center.
GAS HYDRATE MODEL DEVELOPMENT AND VALIDATION

M. Burshears and K. Dominic Aug. 1987 14 p
(DE88-001004; DOE/METC-88-4075) Avail: NTIS HC A03/MF A01

A two-phase, three-dimensional numerical model was developed to simulate the dissociation and formation of hydrates (composed of water and any stable mixture of methane, ethane, or propane) when a conventional gas reservoir is in contact with hydrates. This model was developed in order to address fundamental questions on the feasibility of dissociating hydrates using the depressurization that accompanies production of a conventional gas reservoir. The major implications of the simulation are quite favorable, suggesting that massive hydrate can be dissociated at appreciable rates without an external source of heat energy. These results support the continued evaluation of gas hydrates as a potential resource and indicate a need for model validation. A laboratory simulation of the behavior of a gas hydrate reservoir during pressure reduction was undertaken. In the DOE/METC Gas Hydrates Laboratory, an experiment was designed to produce gas from depressurization and dissociation of synthesized methane hydrate. The flow rate was allowed to vary. The data from this experiment have been used to test and refine the simulator. DOE

N88-17763# Oklahoma Univ., Norman.
PRECIPITATION OF SURFACTANTS AND SURFACTANT MIXTURES IN AQUEOUS SOLUTIONS Ph.D. Thesis

K. L. Stellner 1987 193 p
(Contract DE-FG05-87ER-13678)
(DE88-003333; DOE/ER-13678/7) Avail: NTIS HC A09/MF A01

The precipitation of an anionic surfactant by several different counterions is examined. The counterions include: Na+, Ca+2; and a monovalent counterion which is a cationic surfactant. At concentrations below the CMC (critical micelle concentration), surfactant precipitation is similar to precipitation of any simple salt and can be described by a solubility product relationship. Above the CMC, when micelles are present, the solubility product must be written between the anionic surfactant monomer concentration and the unbound (unassociated) counterion concentration. A model has been developed for each system that successfully predicts the counterion concentration required to cause precipitation. The primary goal of this work is to understand the changes in anionic surfactant precipitation brought about by adding nonionic surfactant and/or NaCl. In anionic-nonionic surfactant mixtures, monomer-micelle equilibrium is described using a pseudo-phase approach combined with a regular solution theory assumption for the micelles. DOE

N88-17764# University of Southern California, Los Angeles. Dept. of Chemistry.
PRODUCT KINETIC AND INTERNAL ENERGY DISTRIBUTIONS VIA VELOCITY-ALIGNED DOPPLER SPECTROSCOPY Technical Report, May 1985 - Jan. 1987

C. Wittig 1987 31 p
(Contract DE-FG03-85ER-13363)
(DE88-003510; DOE/ER-13363/T1) Avail: NTIS HC A03/MF A01

A method of sub-Doppler resolution spectroscopy is developed that is useful for determining kinetic energy distributions. With conventional Doppler spectroscopy, it is almost impossible to obtain an accurate distribution from a line profile, even with the highest resolution, except when the distribution is quite simple (e.g., a delta function). This is due to the lineshape deriving from velocity components along the wave-vector of the probe radiation, k(sub probe). However, by choosing only those species whose velocities are essentially parallel (or antiparallel) to k(sub probe), this handicap is overcome. Here, one obtains the kinetic energy distribution along k(sub probe), and the resolution is limited only by our ability to reject species with velocity components perpendicular to k(sub probe). This rejection is done by spatial and temporal discrimination, using counterpropagating, overlapped, pulsed photolysis and probe sources. At long delays, molecules are detected which are aligned with k(sub probe). The method is called velocity-aligned Doppler spectroscopy (VADS). We have perused several cases involving photodissociation of small molecules, in each case detecting H-atoms using sequential 2-photon ionization via Lyman-£. We discern structure in the kinetic energy distribution which is attributed to internal excitation of the other fragment, and resolution is limited by the dye laser bandwidth. In the case of HBr, we resolve the Br spin-orbit states, and with H2S, we resolve the SH vibrational levels. DOE

N88-17765# Oak Ridge National Lab., Tenn.
OPTIMIZATION OF THE SOUTHERN ELECTROPHORETIC TRANSFER METHOD
M. A. Allison and R. K. Fujimura 1987 12 p
(Contract DE-AC05-76OR-00033)
(DE88-004527; DOE/OR-00033/T382) Avail: NTIS HC A03/MF A01

The technique of separating DNA fragments using agarose gel electrophoresis is essential in the analysis of nucleic acids. Further, after the method of transferring specific DNA fragments from those agarose gels to cellulose nitrate membranes was developed in 1975, a method was developed to transfer DNA, RNA, protein and ribonucleoprotein particles from various gels onto diazobenzyloxymethyl (DBM) paper using electrophoresis as well. This paper describes the optimum conditions for quantitative electrophoretic transfer of DNA onto nylon membranes. This method exemplifies the ability to hybridize the membrane more than once with specific RNA probes by providing sufficient retention of the DNA. Furthermore, the intrinsic properties of the nylon membrane allow for an increase in the efficiency and resolution of transfer while using somewhat harsh alkaline conditions. The use of alkaline conditions is of critical importance since we can now denature the DNA during transfer and thus only a short pre-treatment in acid is required for depurination. DOE

N88-17766# Los Alamos National Lab., N. Mex.
METAL HYDRIDES
J. R. Carnes and N. P. Kherani Nov. 1987 62 p
(Contract W-7405-eng-36)
(DE88-005083; LA-10971-MS) Avail: NTIS HC A04/MF A01

Metal hydride information is not available for most hydrides in a consolidated quick-reference source. This report's objective is to fill the need for such a document providing basic thermodynamic data for as many metal hydrides as possible. We conduced a computerized library search to access as many sources as possible and screened each source for such thermodynamic data as pressure-temperature graphs, Van't Hoff curves, and impurity effects. We included any other relevant information and commented on it. A primary concern to be investigated in the future is the behavior of metal tritides. This would be important in the area of emergency tritium cleanup systems. The hydride graphs are useful, however, as tritides may be expected in most cases to behave similarly and at least follow trends of their respective hydrides. DOE

N88-17767# Stanford Univ., Calif. Lab. of Physics.
CRYOGENIC ACOUSTIC MICROSCOPY Final Technical Report, 1 Apr. 1985 - 31 Mar. 1987
C. F. Quate and B. Hadimioglu Aug. 1987 62 p
(Grant AF AFOSR-0168-85)
(AD-A187274; GL-4240; AFOSR-87-1580TR) Avail: NTIS HC A04/MF A01 CSCL 07D

This work describes the advancements in the field of acoustic microscopy in superfluid helium at temperatures near 0.1 K. The microscope is presently capable of imaging materials using 300 A sound waves with 200 A resolution. Current developments include the search for operation of higher frequencies in order to get better resolution and improvements in the signal-to-noise ratio to get better images. A new technique has been developed to fabricate high efficiency acoustic transducers at ultrahigh frequencies. These transducers consist of multilayers of zinc oxide with alternating crystal structure. Multilayer transducers fabricated with the new technique are shown to convert nearly 10 percent of the electrical input power to acoustic power at frequencies as high as 30 GHz. This is several orders of magnitude better than any of the previous experiments. GRA

N88-17768# Minnesota Univ., Minneapolis. Dept. of Chemical Engineering and Materials Science.
YTTERBIUM MONOLAYER DIFFUSION BARRIERS AT Hg(1-x)Cd(x)Te/Al JUNCTIONS Interim Report, 1 Aug. 1986 - 31 Aug. 1987
A. Franciosi, A. Raisanen, A. Wall, S. Chang, and P. Philip 23 Oct. 1987 14 p Prepared in cooperation with McDonnell-Douglas Research Labs., St. Louis, Mo.
(Contract N00014-84-K-0545)
(AD-A188013) Avail: NTIS HC A03/MF A01 CSCL 07B

Single layers of Yb at the Hg1-xCdxTe(110)/Al interface prevent Al-Te reaction and dramatically increase the Hg concentration at the interface. The interlayer-induced change in atomic interdiffusion results in an increase of over two orders of magnitude in the Hg/Te ratio in the junction region. Semi-empirical calculations of thermodynamic parameters following Miedema's model suggest that other rare earths should also act as effective diffusion barriers at Hg2-XCdXTe/reactive metal junctions. GRA

N88-17769# National Aerospace Lab., Tokyo (Japan).
CARS MEASUREMENTS OF COMBUSTION. 1: PRECISION OF THERMOMETRY
Yasuo Watanabe, Mitsuo Gomi, Kunihisa Eguchi, and Atsumu Tezaki Aug. 1987 14 p In JAPANESE; ENGLISH summary
(NAL-TR-939; ISSN-0389-4010) Avail: NTIS HC A03/MF A01

Nitrogen coherent anti-Stokes Raman spectroscopy (CARS) spectra obtained from the post flame gases in a flat flame burner were analyzed and the accuracy of the resulting temperatures is discussed. It is shown that referencing on the time-averaged signals gives accurate spectra comparable to theoretical ones by eliminating the effects of low frequency modulation of the broadband dye laser. Referencing on single pulse measurements gives correct average temperatures but cannot eliminate the influence of high frequency dye laser noise. Both full and quick fitting methods are applied to the determination of temperatures and the results are compared and evaluated. Author

N88-17770# National Aerospace Lab., Tokyo (Japan).
ANALYSIS OF A TURBULENT PREMIXED V-FLAME (INFLUENCE OF FLAME-THICKENING)
Goro Masuya Aug. 1987 13 p In JAPANESE; ENGLISH summary
(NAL-TR-941; ISSN-0389-4010) Avail: NTIS HC A03/MF A01

The Bray-Moss-Libby model with an improved laminar flamelet model was applied to a turbulent premixed V-flame to confirm validity of the model as well as to investigate influence of flame-thickening on the turbulence structure of the flame. The V-flame is approximated as a circumferentially one-dimensional flame in a cylindrical coordinate. Various additional terms appear in the governing equations for such a flame in comparison with those for a planar flame with constant thickness. Because of the new terms, a model for the mean reaction rate, which is not necessary for a constant thickness flame, is introduced. The other terms are closed using the same model as that for a constant

thickness flame. The calculated profiles of the mean velocity, the turbulent diffusion flux, and the Reynolds stress agree very well with those measured by Cheng. The prediction is compared to that for a constant thickness flame with the same upstream conditions. In the V-flame, the flame-generated turbulence is significantly suppressed by a decrease in magnitude of mean pressure gradient, whereas the counter-gradient diffusion flux governed by acceleration across laminar flamelets is almost unchanged. Author

26 METALLIC MATERIALS

Includes physical, chemical, and mechanical properties of metals, e.g., corrosion; and metallurgy.

N88-17771# Japan Atomic Energy Research Inst., Tokyo.
APPLICATION OF ac-IMPEDANCE METHOD ON DETERMINATION OF CORROSION RATE OF METALS
Motoe Suzuki Jul. 1987 38 p In JAPANESE
(DE88-750307; JAERI-M-87-095) Avail: NTIS (US Sales Only) HC A03/MF A01

The ac-impedance technique was experimentally evaluated as one of the in-situ measuring means to determine the corrosion rate of metals immersed in aqueous solutions. Surface impedance of corroding metals was measured by both the FET and FRA methods using the system consisting of a personal computer and digital wave memories, and the two methods were compared with respect to accuracy and error factors. The tested systems were stainless steel-sulfuric acid, stainless steel-chloric acid, titanium-nitric acid and zirconium-nitric acid. The measurement permitted to estimate a very low corrosion current density of firmly passivated specimens. For the stainless steel corroding actively in chloric acid, weight change of the specimen calculated from its impedance data was coincided within 2.5 percent difference with the value determined by direct weighing. This indicates the capability of the impedance technique to determine corrosion rate of sample on the basis of the previously obtained correlation between measured weight change and impedance data of the same metal-solution system as the sample. In other words, on-line sensing of corrosion rate is possible. DOE

N88-17772# Admiralty Research Establishment, Poole (England).
THE EFFECT ON INITIAL BOND STRENGTH AND DURABILITY OF A PHOSPHORIC ACID DIP (PAD) FOLLOWING CHROMIC ACID ANODISING OF ALUMINUM
D. A. Moth Mar. 1987 29 p
(ARE-TM(UMM)-87402; BR102091; ETN-88-91511) Copyright Avail: NTIS HC A03/MF A01

The effect of a phosphoric acid dip following chromic anodizing of aluminum on initial bond strength and durability in an aggressive environment was investigated. The topography obtained after etching and the degree of surface wetting, with and without a primer, were studied using the scanning electron microscope, and compared with results obtained from phosphoric acid anodizing. Results indicate that to achieve high strength bonds good surface wetting is extremely important. The incorporation of phosphate ions into the surface to be bonded is necessary. ESA

N88-17773# Brookhaven National Lab., Upton, N. Y.
MECHANISMS OF INTERGRANULAR ATTACK AND STRESS CORROSION CRACKING OF ALLOY 600 BY HIGH-TEMPERATURE CAUSTIC SOLUTIONS CONTAINING IMPURITIES Final Report
D. VanRooyen and R. Bandy Jul. 1987 188 p Prepared in cooperation with California State Univ., Sacramento and Electric Power Research Inst., Palo Alto, Calif.
(Contract DE-AC02-76CH-00016)
(DE87-012820; EPRI-NP-5129) Avail: NTIS HC A09/MF A01

The mechanisms of intergranular attack (IGA) and intergranular stress corrosion cracking (SCC) of Alloy 600 are investigated in high temperature sodium hydroxide environments contaminated with impurities such as carbonate, sulfate, silicate, magnetite, and chromic oxide. Results show that caustic alone can cause both IGA and SCC. The effects of electrochemical potential, stress, time, temperature and the metallurgical state of Alloy 600 on the IGA and SCC are discussed. It appears that both IGA and SCC are manifestations of a general intergranular failure process. In the presence of adverse potential, stress, strain rate and temperature, the slower IGA process is generally replaced by the faster SCC process. DOE

N88-17774# Argonne National Lab., Ill.
EFFECT OF LOW-TEMPERATURE AGING ON THE MECHANICAL PROPERTIES OF CAST STAINLESS STEELS
O. K. Chopra and H. M. Chung Jul. 1987 47 p Presented at the Symposium on Properties of Stainless Steels in Elevated Temperature Service, Boston, Mass., 13 Dec. 1987
(Contract W-31-109-eng-38)
(DE88-002872; CONF-871232-2) Avail: NTIS HC A03/MF A01

The significance of in-service embrittlement of cast duplex stainless steels under light-water operating conditions was investigated. Mechanical property data are presented from Charpy-impact, tensile, and J-R curve tests for several heats of cast stainless steel aged up to 10,000 h at 450, 400, 350, 320, and 290 C. Thermal aging increased the tensile strength and decreased the impact energy, J/sub IC/, and tearing modulus of the steels. Also, the ductile-to-brittle transition curve shifted to higher temperatures. Fracture toughness results were consistent with the Charpy-impact data. The ferrite content and concentration of C in the steel had a strong effect on the overall process of low-temperature embrittlement. The low-carbon CF-3 steels were the most resistant and Mo-containing CF-8M steels were most susceptible to embrittlement. Weakening of the ferrite/austenite phase boundaries by carbide precipitates had a significant effect on the kinetics and extent of embrittlement of the high-carbon CF-8 and CF-8M steels, particularly after aging at temperatures greater than or equal to 400 C. The influence of N content and distribution of ferrite on loss of toughness are discussed. DOE

N88-17775# NUCLEP, Rio de Janeiro (Brazil).
INFLUENCE OF NON-METALLIC ELEMENTS IN THE MECHANICAL PROPERTIES OF 20 Mn Mo Ni 55 STEEL
J. C. B. R. Cardoso 1987 60 p In PORTUGESE
(DE88-700412; INIS-BR-878) Avail: NTIS (US Sales Only) HC A04/MF A01

Usual methods for determining non-metallic elements in steels are studied. Those methods are: (1) Standard methods of ASTM and ISO, and (2) Modern and fast methods of detection, non-standard. The steel used was 20 Mn Mo Ni 55. DOE

N88-17776# Atomic Energy Research Establishment, Harwell (England). Materials Development Div.
THE INFLUENCE OF THE HEATING PROCEDURE ON THE OXIDATION BEHAVIOUR OF NiAl STUDIED BY XPS
E. W. A. Young (Philips Gloeilampenfabrieken N. V., Eindhoven, Netherlands), J. C. Riviere, and L. S. Welch May 1987 10 p
(AERE-R-12498; HL87/1204) Avail: NTIS HC A02/MF A01

The initial stages of oxidation of NiAl at 870 K were investigated with emphasis on the influence of the sample heating procedure. The compositions of the oxide films were analyzed by XPS. The results show that if the NiAl is brought to temperature in vacuum before the admission of oxygen, scales of pure alumina develop. On the other hand, if the material is pre-oxidized at 670 K for a few minutes, a film rich in NiAl2O4 forms; subsequent oxidation at the higher temperature then produces not a pure alumina scale but one still rich in the aluminate. It seems, therefore, that if the initially formed scale, which is to form the starting point for the controlled growth of a textured alumina microstructure, is to avoid the inclusion of a textured alumina microstructure, is to avoid the inclusion of Ni oxides, it should be grown on a vacuum heated surface. This may be a possible alternative to the traditional rapid heating procedures. Author

N88-17777# Atomic Energy Research Establishment, Harwell (England). Materials Physics and Metallurgy Div.
A DETAILED MICROSTRUCTURAL EXAMINATION OF THE CAUSE OF HAZ CRACKING IN TYPE 316 STEEL
C. M. Shepherd Jan. 1987 36 p
(AERE-R-12428; FRDCC/MWG/P(86)389; FRDCC/MWG/MPSG/P(86)171; FRDCC/MWG/FSG/P(86)77; HL87/1006) Avail: NTIS HC A03/MF A01

Detailed metallography was performed on bead-on-plate, submerged-arc welds made on two 50 mm thick plates of type 316 steel. One of the plates was known to be susceptible to heat affected zone (HAZ) cracking, while the other was not. Boron autoradiography of both welds indicates no concentrations of boron in the HAZ region which might be incorporated in a low melting point phase. High spatial resolution X-ray analysis has been unable to find any chemical differences between the interfaces in the two plates, but it has shown enrichment of P, Mo, Cr and Si at interfaces both in the weld metal and the plates. Author

N88-17778# Atomic Energy Research Establishment, Harwell (England). Materials Development Div.
STUDIES OF THE INITIATION OF PITTING CORROSION ON STAINLESS STEELS
J. Stewart and D. E. Williams May 1987 28 p
(AERE-M-3615; HL87/1224) Avail: NTIS HC A03/MF A01

For type 304L stainless steel in dilute aqueous sodium chloride solutions, preliminary studies show good correspondence between the nucleation frequency of unstable pits (lambda) and the frequency of occurrence of propagating pits (lambda). Whilst reliable determination of lambda requires a large number of experiments, it is shown that reasonable estimates of lambda can be obtained using a relatively small number of specimens. Unstable pitting events were observed at low potentials even in very dilute chloride solutions, implying some finite probability of failure under these conditions. This prediction was confirmed by long term immersion tests, in which failure occurred due to pitting corrosion in stagnant aerated 10 ppm Cl(-) solutions (E approximately equals -50 mV sce). A chloride concentration dependent effect of oxide film thickness on pitting breakdown probability was identified by comparing freshly ground and prepitted (and thus anodically polarized) specimens. Prepitted specimens did not nucleate stable pits at lower potentials then the equivalent fresh ground specimens (as renewal theories might predict). Author

N88-17779# Atomic Energy Research Establishment, Harwell (England). Materials Development Div.
BENEFICIAL AND DETRIMENTAL EFFECTS OF SILICA IN THE HIGH TEMPERATURE OXIDATION OF 20Cr/25Ni/Nb STAINLESS STEEL
M. J. Bennett May 1987 27 p Presented at the 10th International Metallic Corrosion Congress, Madras, Spain, 7-11 Nov. 1987 Sponsored in part by Central Electricity Generating Board, United Kingdom
(AERE-R-12667; FPWG/P1009; HL87/1213) Avail: NTIS HC A03/MF A01

The crucial influence of silicon upon the oxidation behavior of the 20/25Nb stainless steel in carbon dioxide, at temperatures of up to 1200 C, is the subject of continuing investigation. Recent studies have utilized a range of surface analytical techniques, in association with speciment preparation procedures, to provide mechanistic understanding of how exactly silicon is involved. Analytical electron microscopy has revealed that during oxidation of the 20/25/Nb stainless steel in carbon dioxide at approximately or less than 900 C the final component of the uniform protective oxide scale formed, is a thin, amorphous, silica layer at the interface with the underlying steel. A detrimental effect of the continuous silica layer, however, is that it provides a defined fracture plane for scale spallation on cooling. Loss of the protective scale exposes underlying steel depleted in chromium, which on re-oxidation is attacked internally until a sufficiently high chromium concentration is attained to form a Cr2O3, with an underlying silica, healing layer at the base of the corrosion pit. Above 900 C oxidation of the 20/25/Nb stainless steal may be described in general terms as changing from protective to nonprotective type behavior in which silica no longer exercises a major control on scale growth and failure. The silica intrusions affect the mechanical properties of the 20/25/Nb stainless steel to the depth of this intergranular attack as fracture at 78 K occurs by a brittle mode. In contrast, the region of the steel unaffected by oxidation remains ductile. Author

N88-17780 Cornell Univ., Ithaca, N.Y.
A LARGE STRAIN THERMOMECHANICAL FORMING MODEL FOR ELASTIC-VISCOPLASTIC BEHAVIOR IN METALS Ph.D. Thesis
Geoffrey Mark Eggert [1987] 81 p
Avail: Univ. Microfilms Order No. DA8724168

A formulation for elastic-viscoplastic flow is presented which retains the basic structure of the viscoplastic formulations. Elasticity is included in an integral sense over a time step by modifying the flow properties of the material to account for the change in the elastic strain over the step. Consistency between the elastic strain and the inelastic deformation rate is enforced. The approach retains the determinism of the velocities for traction boundary conditions without apparent numerical instability. The method is demonstrated by application to two problems. Application to the problem of a thick walled cylinder, for which a semi-analytical solution might be obtained, demonstrates the stability and accuracy of the method given a known initial solution. Application to the simulation of upset welding, for which experimental results are available for comparison, demonstrates the ability of the method to handle more complicated phenomena. Dissert. Abstr.

N88-17781# Argonne National Lab., Ill.
DIFFUSION STUDIES IN AMORPHOUS NiZr ALLOYS
H. Hahn, R. S. Averback, K. Hoshino, and S. J. Rothman Jun. 1987 12 p Presented at the 6th International Conference on Rapidly Quenched Metals, Montreal, Quebec, 3 Aug. 1987 Prepared in cooperation with Illinois Univ., Urbana.
(Contract W-31109-eng-38)
(DE88-003009; CONF-870893-6) Avail: NTIS HC A03/MF A01

Tracer impurity and self diffusion measurements have been made on amorphous (a-) NiZr alloys using radioactive tracer, Secondary Ion Mass Spectrometry and Rutherford backscattering techniques. The temperature dependence of diffusion in a-NiZr can be represented in the form D = D(sub o)exp(-Q/kT), with no structural relaxation effects being observed. The mobility of an atom in a-NiZr increased dramatically with decreasing atomic radius of the diffusing atom and also with decreasing Ni content for Ni concentrations below or approximately equal to 40 at. percent. These diffusion characteristics in a-NiZr are remarkably similar to those in alpha-Zr and alpha-Ti. These mechanisms assume that Zr and Ti provide a close packed structure, either crystalline or amorphous, through which small atoms diffuse by an interstitial mechanism and large atoms diffuse by a vacancy mechanism. DOE

N88-17782*# Virginia Univ., Charlottesville. Dept. of Materials Science.
ENVIRONMENT ASSISTED DEGRADATION MECHANISMS IN ALUMINUM-LITHIUM ALLOYS Progress Report
Richard P. Gangloff, Glenn E. Stoner, and Robert E. Swanson (Virginia Polytechnic Inst. and State Univ., Blacksburg.) Jan. 1988 255 p
(Grant NAG1-745)
(NASA-CR-182482; NAS 1.26:182482; UVA/528266-MS88-101)
Avail: NTIS HC A12/MF A01 CSCL 11F

Section 1 of this report records the progress achieved on NASA-LaRC Grant NAG-1-745 (Environment Assisted Degradation Mechanisms in Al-Li Alloys), and is based on research conducted during the period April 1 to November 30, 1987. A discussion of work proposed for the project's second year is included. Section 2 provides an overview of the need for research on the mechanisms of environmental-mechanical degradation of advanced aerospace alloys based on aluminum and lithium. This research is to provide NASA with the basis necessary to permit metallurgical optimization

of alloy performance and engineering design with respect to damage tolerance, long term durability and reliability. Section 3 reports on damage localization mechanisms in aqueous chloride corrosion fatigue of aluminum-lithium alloys. Section 4 reports on progress made on measurements and mechanisms of localized aqueous corrosion in aluminum-lithium alloys. Section 5 provides a detailed technical proposal for research on environmental degradation of Al-Li alloys, and the effect of hydrogen in this. F.M.R.

N88-17783# Army Combat Systems Test Activity (Provisional), Aberdeen Proving Ground, Md.
CORROSION AND DETERIORATION TESTING IN HUMID TROPIC ENVIRONMENTS Final Report
4 Nov. 1987 20 p
(AD-A186917; AMSTE-RP-702-100; TOP-1-1-061) Avail: NTIS HC A03/MF A01 CSCL 11F

General procedures for corrosion and degradation tests of materials and material systems in humid tropic environments are described. GRA

N88-17784*# Clarkson Univ., Potsdam, N.Y. Dept. of Chemical Engineering.
INFLUENCE OF CONVECTION ON MICROSTRUCTURE Final Report, 15 Jun. 1984 - 31 Dec. 1987
William R. Wilcox, Gaber Faheem Eisa, S. Chandrasekhar, Mark Larrousse, and Mohsen Banan Feb. 1988 213 p
(Grant NAG8-480)
(NASA-CR-182489; NAS 1.26:182489) Avail: NTIS HC A10/MF A01 CSCL 11F

The influence was studied of convection during directional solidification on the resulting microstructure of eutectics, specifically lead/tin and manganese/bismuth. A theory was developed for the influence of convection on the microstructure of lamellar and fibrous eutectics, through the effect of convection on the concentration field in the melt in front of the growing eutectic. While the theory agrees with the experimental spin-up spin-down results, it predicts that the weak convection expected due to buoyancy will not produce a measurable change in eutectic microstructure. Thus, this theory does not explain the two fold decrease in MnBi fiber size and spacing observed when MnBi-Bi is solidified in space or on Earth with a magnetic field applied. Attention was turned to the morphology of the MnBi-Bi interface and to the generation of freezing rate fluctuations by convection. Decanting the melt during solidification of MnBi-Bi eutectic showed that the MnBi phase projects into the melt ahead of the Bi matrix. Temperature measurements in a Bi melt in the vertical Bridgman-Stockbarger configuration showed temperature variations of up to 25 C. Conclusions are drawn and discussed. Author

N88-17785# Pacific Northwest Labs., Richland, Wash.
RESPONSE OF Fe-Cr-Mn AUSTENITIC ALLOYS TO THERMAL AGING NEUTRON IRRADIATION
F. A. Garner, F. Abe, and T. Noda Sep. 1987 20 p Presented at the 3rd International Conference on Fusion Reactor Materials, Karlsruhe, Fed. Republic of Germany, 4 Oct. 1987 Prepared in cooperation with National Research Inst. for Metals, Tokyo, Japan
(Contract DE-AC06-76RL-01830)
(DE88-003415; PNL-SA-15322; CONF-871036-29) Avail: NTIS HC A03/MF A01

The Fe-Cr-Mn austenitic alloy system is being studied as a replacemnet of the Fe-Cr-Ni system for fusion applications in which reduced long-term radioactivation is an important consideration. This paper describes two aspects of the respone of this alloy system to material and environmental variables. First, the neutron-induced void swelling of simple binary and ternary alloys is investigated as a function of composition, thermal-mechanical treatment, temperature (693 to 873K) and displacement level (9 to 76 dpa). The swelling rate of this alloy system approaches 1 percent/dpa for those conditions which do not favor formation of large levels of ferrite phases. Second, the tendency of the potentially detrimental sigma phase to form during thermal aging is explored at high manganese levels. Variables such as carbon concentration, cold-work level and aging time are shown to influence the distribution and rate of sigma formation. DOE

N88-17786# Pacific Northwest Labs., Richland, Wash.
EFFECTS OF THE NEUTRON SPECTRUM ON MECHANICAL PROPERTY CHANGES IN LOW DOSE IRRADIATIONS
H. L. Heinisch Sep. 1987 31 p Presented at the 3rd International Conference on Fusion Reactor Materials, Karlsruhe, Fed. Republic of Germany, 4 Oct. 1987
(Contract DE-AC06-76RL-01830)
(DE88-003429; PNL-SA-15264; CONF-871036-31) Avail: NTIS HC A03/MF A01

Mechanical property measurements from comparative low dose irradiations of metals and alloys are reviewed. The emphasis is on recent experiments involving miniature tensile specimens irradiated at the Rotating Target Neutron Source II (RTNS-II) at Lawrence Livermore National Laboratory and the Omega West Reactor at Los Alamos National Laboratory. Pure metals, model alloys and structural alloys have been irradiated in RTNS-II from room temperature to 723 K to fluences as high as 8 x 10 to the 22nd n/sq m. Where temperature effects are apparent, the effect of increasing the irradiation temperature is to delay the onset of irradiation hardening to higher fluence. Companion fission reactor irradiations have been more limited in scope, but comparative information has been obtained on tensile properties at irradiation temperatures of 363 K and 563 K. For most of the materials tested the differences in the neutron energy spectrum can be accounted for by using displacements per atom (DPA) as a correlation parameter. Pure copper and niobium are well known exceptions. There is also evidence for rate effects in some of the data, obscuring the examination of DPA as a correlation parameter. DOE

N88-17787# Brookhaven National Lab., Upton, N. Y.
A REVIEW OF PITTING CORROSION IN HIGH TEMPERATURE AQUEOUS SOLUTIONS
G. Cragnolino 1987 84 p Presented at the International Conference on Localized Corrosion, Orlando, Fla., 1 Jun. 1987
(Contract DE-AC02-76CH-00016)
(DE88-003547; BNL-40430; CONF-870658-4) Avail: NTIS HC A05/MF A01

Pitting corrosion of metals and alloys in aqueous solutions containing aggressive anions at temperatures ranging from 100 to 300 C is reviewed. Following a discussion about reference electrodes and electrode potential scales, the effect of temperature on pitting and repassivation potentials is examined. Effects of alloy composition and environmental variables, such as nature and concentration of aggressive anions, inhibitors and pH, are discussed to emphasize the influence of temperature on the pitting corrosion behavior. Composition, structure and properties of passive films in high temperature aqueous solutions are briefly examined to explain how temperature affects the location of the attack and the pitting morphology. Existing models of pitting corrosion may not be suitable to explain the phenomenon at temperatures above 150 to 200 C, but are applicable at lower temperatures. DOE

N88-17788# Michigan State Univ., East Lansing.
DYNAMIC RECRYSTALLIZATION DURING HIGH TEMPERATURE LOW CYCLE FATIGUE OF NICKEL Progress Report, 1 Jun. 1985 - 31 May 1988
G. Gottstein Nov. 1987 8 p
(Contract DE-FG02-85ER-45205)
(DE88-003224; DOE/ER-45205/3) Avail: NTIS HC A02/MF A01

The mechanical behavior and the microstructural development associated with high-temperature low-cycle fatigue of nickel and static recrystallization of Ni3Al were investigated. The occurrence of dynamic recrystallization during high-temperature low-cycle fatigue was substantiated. However, for the investigated range of strain amplitudes (epsilon less than or equal to 1.5 percent) dynamic recrystallization occurs only in polycrystals, but not in single crystals. Aluminum polycrystals were found not to undergo dynamic

recrystallization during low cycle fatigue, in line with its behavior in monotonic deformation. Dynamic recrystallization during high temperature low cycle fatigue is associated with extensive prior grain boundary migration. It invariably leads to grain refinement and work softening. An experimental setup and computer code was developed to utilize synchrotron radiation for fully automatic orientation mapping. DOE

N88-17789# Du Pont de Nemours (E. I.) and Co., Aiken, S.C.
IRRADIATION EFFECTS IN METALS
G. R. Caskey, Jr. 1987 7 p Presented at the International Conference on Environmental Degradation of Engineering Materials, University Park, Pa., 13 Apr. 1987
(Contract DE-AC09-76SR-00001)
(DE88-004272; DP-MS-87-14; CONF-870466-6) Avail: NTIS HC A02/MF A01

Recent irradiation damage studies on structural alloys have been reviewed to highlight select research efforts currently of interest. The literature on irradiation damage and irradiation effects is extensive, conference proceedings alone accounting for many hundreds of papers. Consequently, literature citations have been included only when directly relevant to topics covered in the present conference, namely; swelling and cavity formation; creep, fracture and helium embrittlement. DOE

N88-17790# Los Alamos National Lab., N. Mex.
EFFECTS OF COMMERCIAL CLADDING ON THE FRACTURE BEHAVIOR OF PRESSURE VESSEL STEEL PLATES
S. K. Iskander, D. J. Alexander, S. E. Bolt, K. V. Cook, W. R. Corwin, B. C. Oland, R. K. Nanstad, and G. C. Robinson 1987 16 p Presented at the 15th Water Reactor Safety Information Meeting, Gaithersburg, Md., 26 Oct. 1987
(Contract DE-AC05-84OR-21400)
(DE88-004333; CONF-8710111-20) Avail: NTIS HC A03/MF A01

The objective of this program is to determine the effect, if any, of stainless steel cladding on the propagation of small surface cracks subjected to stress states similar to those produced by thermal shock conditions. Preliminary results from testing at temperatures 10 and 60 C below NDT have shown that: (1) a tough surface layer (cladding and/or HAZ) has arrested running flaws under conditions where unclad plates have ruptured, and (2) the residual load-bearing capacity of clad plates with large subclad flaws significantly exceeded that of an unclad plate. DOE

N88-17791# Colorado School of Mines, Golden. Center for Welding and Joining Research.
THE ROLE OF COMPOSITION AND MICROSTRUCTURE GRADIENTS ON WELD METAL PROPERTIES AND BEHAVIOR Progress Report, 1 Jun. - 31 Dec. 1987
D. K. Matlock and D. L. Olson Jan. 1988 68 p
(Contract DE-FG02-87ER-45308)
(DE88-004956; DOE/ER-45308/1; MT-CWR-088-003) Avail: NTIS HC A04/MF A01

The effects of weld metal compositional and microstructural gradients on phase transformations, microstructural stability, and mechanical properties are considered from a fundamental basis in weld metal alloys which are primarily austenitic (e.g., stainless steels). Models which incorporate compositional gradients are developed to predict the resulting weld metal properties. The mechanical properties of weld metals are modeled based on composite theory in which individual weld metal zones are considered as discrete elements within a composite structure. DOE

N88-17792# Mound Lab., Miamisburg, Ohio.
TRANSMISSION ELECTRON MICROSCOPY STUDIES OF TITANIUM-CONTAINING BRAZE/ALUMINA SEALS
W. E. Moddeman, R. T. Cassidy, and P. B. Fraundorf 15 Jan. 1988 24 p
(Contract DE-AC04-76DP-00053)
(DE88-005243; MLM-3470) Avail: NTIS HC A03/MF A01

A study was undertaken to determine interfacial compounds of an active braze/alumina seal by transmission electron microscopy to increase understanding of the role of titanium in the braze alloy. A high-resolution, 300 kV Phillips transmission electron microscope was used to examine the interfacial characteristics of a braze joint between an active braze alloy and a 94 percent Al2O3 ceramic. Results indicated the presence of both a copper-titanium compound and titanium oxide at the interface. These results agreed well with previous findings which, through the use of Auger electron spectroscopy and wavelength dispersive analysis, determined the presence of a copper-titanium compound (Cu(sub x)Ti where 1.2 is less than x is less than 1.6) and titanium dioxide. DOE

N88-17793# Worcester Polytechnic Inst., Mass. Dept. of Mechanical Engineering.
EFFECTS OF ION IMPLANTATION ON CAVITATION EROSION OF A COBALT BASED METAL/CARBIDE ALLOY Final Report, 1 Jun. 1986 - 30 Aug. 1987
Sara A. Dillich Sep. 1987 65 p
(Contract N00014-86-K-0391)
(AD-A187239) Avail: NTIS HC A04/MF A01 CSCL 11F

The goal of this work was to characterize the cavitation erosion wear mechanisms in a cobalt based superalloy and to investigate how these could be altered by high fluence titanium and nitrogen implantations. Both titanium and nickel implantations significantly improved the cavitation erosion resistance of the alloy, primarily through implantation effects in the cobalt rich matrix phase. The titanium implanted samples showed the highest erosion resistances, as a result of the microstructural changes produced in the alloy during implantation. Namely, a carburized surface layer was formed, with an amorphous matrix phase and recrystallized carbides. A corresponding toughening of the matrix phase and decrease in the elastic modulus difference between matrix and carbide phases can account for the observed increased erosion resistance of this phase and enhanced carbide-matrix cohesion. Nitrogen implantation stabilized the metastable FCC matrix phase of the alloy (i.e., inhibited stress induced martensitic FACC to HCP transformations in the cobalt rich phase) with consequent prolonged matrix phase ductility and decreased carbide-matrix debonding during cavitation erosion. GRA

N88-17794# Martin Marietta Labs., Baltimore, Md.
CORROSION BEHAVIOR OF SPUTTER-DEPOSITED ALUMINUM-BASED ALLOYS EXPOSED TO CHLORIDE SOLUTIONS Annual Report, 1 Jul. 1986 - 30 Jun. 1987
William C. Moshier, G. D. Davis, G. O. Cote, H. F. Hough, and M. E. Vogelsang 30 Sep. 1987 42 p
(Contract N00014-85-C-0638)
(AD-A187262; MML-TR-87-75C) Avail: NTIS HC A03/MF A01 CSCL 11F

In year two of the program, the investigation of the passivity of sputter-deposited Al alloys has been extended from Al-Mo and Al-Cr to include Al-Ta, Al-Zr, Al-Si, and Al-Cu. Al-Ta was found to have the greatest effect on the breakdown potential of Al. Al-Mo, Al-Zr, and Al-Cr also substantially impact the breakdown potential, whereas Al-Cu and Al-Si have little or no effect. A more extensive study of the corrosion behavior of Al-Mo and Al-Cr was performed in salt spray and pit initiation tests. Whereas the Al-Cr alloys out-performed the Al-Mo allosys in the salt spray tests, both alloys were substantially more resistant to attack than pure aluminum. Pit initiation tests showed that the order of the reaction between the alloys and pure Al was identical. However, the time required to initiate a pit was substantially longer for Al-Mo than for Al-Cr or pure Al, indicating that the mechanism by which pits nucleate and grow through the film may be different. GRA

N88-17795# Ohio State Univ., Columbus.
STRENGTH AND STRUCTURE OF Ga SUB 1-xIn SUB xAs ALLOYS Annual Report, 1 Sep. 1986 - 31 Aug. 1987
Katherine T. Faber and John P. Hirth 30 Sep. 1987 45 p
(Contract F49620-85-C-0129; ARPA Order 5526)

(AD-A188092; AFOSR-87-1633TR) Avail: NTIS HC A03/MF A01 CSCL 11F

Solid solution strengthening of GaAs by In atoms acting as InAs 4 units has been predicted for an intermediate temperature, plateau region. This strengthening could partially account for the reduction in dislocation density in crystals grown from the melt. Deformation studies of undoped and In-doped (1-2X 10 to the 20th atoms/cu cm GaAs were performed in compression in the temperature range 500 - 1100 C at a strain rate of .0001/s in both multiple slip, 001, and single slip, 123, orientations. The critical resolved shear stress is nearly doubled with indium additions, but both undoped and In-doped materials show a weakly temperature independent critical resolved shear stress, expected from the solid solution strengthening model. The results also showed that the onset of dynamic recovery occurred at higher stress and strain levels for the In-doped materials, suggesting that the climb process is more difficult in these alloys. GRA

27 NONMETALLIC MATERIALS

Includes physical, chemical, and mechanical properties of plastics, elastomers, lubricants, polymers, textiles, adhesives, and ceramic materials.

For composite materials see *24 Composite Materials*.

N88-17796*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.

FRICTION AND WEAR OF MONOLITHIC AND FIBER REINFORCED SILICON-CERAMICS SLIDING AGAINST IN-718 ALLOY AT 25 TO 800 C IN ATMOSPHERIC AIR AT AMBIENT PRESSURE

Daniel L. Deadmore and Harold E. Sliney Feb. 1988 31 p

(NASA-TM-100294; E-3942; NAS 1.15:100294) Avail: NTIS HC A03/MF A01 CSCL 11B

The friction and wear of monolithic and fiber reinforced Si-ceramics sliding against the nickel base alloy IN-718 at 25 to 800 C was measured. The monolithic materials tested were silicon carbide (SiC), fused silica (SiO2), syalon, silicon nitride (Si3N4) with W and Mg additives, and Si3N4 with Y2O3 additive. At 25 C fused silica had the lowest friction while Si3N4 (W,Mg type) had the lowest wear. At 800 C syalon had the lowest friction while Si3N4 (W,Mg type) and syalon had the lowest wear. The SiC/IN-718 couple had the lowest total wear at 25 C. At 800 C the fused silica/IN-718 couple exhibited the least total wear. SiC fiber reinforced reaction bonded silicon nitride (RBSN) composite material with a porosity of 32 percent and a fiber content of 23 vol percent had a lower coefficient of friction and wear when sliding parallel to the fiber direction than in the perpendicular at 25 C. The coefficient of friction for the carbon fiber reinforced borosilicate composite was 0.18 at 25 C. This is the lowest of all the couples tested. Wear of this material was about two decades smaller than that of the monolithic fused silica. This illustrates the large improvement in tribological properties which can be achieved in ceramic materials by fiber reinforcement. At higher temperatures the oxidation products formed on the IN-718 alloy are transferred to the ceramic by sliding action and forms a thin, solid lubricant layer which decreases friction and wear for both the monolithic and fiber reinforced composites. Author

N88-17797# Massachusetts Univ., Amherst.

THERMOPLASTIC ELASTOMERS AS LOVA BINDERS Annual Report

James C. Chien, Richard J. Farris, C. P. Lillya, and H. H. Winter 1986 4 p

(Contract N00014-85-K-0880)

(AD-A186563) Avail: NTIS HC A02/MF A01 CSCL 07C

For the first time main chain liquid crystalline polymers have been synthesized. Both polyalkylene oxides and polyfluoroformals (NSWC) have been incorporated as spacers. Mesophase transitions were designed and found to occur at processing temperatures. Structural orders have been shown to exist above clearing temperature by both rheological and spectroscopic measurements. Acid dopolymerizable trioxanne dioxolane hard segments have been synthesized with adjustable melt temperatures from 70 C to 138 C. Synthesis of completely acid depolymerizable LOVA TPE binders have been scaled up by Olin for sampling to China Lake and Aberdeen. GRA

N88-17798# Atomic Energy Research Establishment, Harwell (England). Materials Development Div.

BIAS, INTERNAL STRESS AND SUBSTRATE EFFECTS ON THE MICROSTRUCTURE AND PROPERTIES OF PVD-WEAR RESISTANT COATINGS

D. S. Rickerby and P. J. Burnett (Oxford Univ., England) Oct. 1986 45 p Sponsored by the Department of Trade and Industry, United Kingdom

(AERE-R-12360; HL86/1437) Avail: NTIS HC A03/MF A01

The effect of the process parameter substrate bias on the internal stress, microstructure, and hardness of sputter ion plated titanium nitride coatings was investigated. It is found that high bias levels results in coatings of fine grain size, high internal stress, low porosity, and high hardness. The role of the thermal mismatch contribution to internal stress in densification of the coating is elucidated. Hardness anisotropy was observed when indenting plan and cross-sections of thick (approximately 20 microns) TiN and WTiC coatings. An explanation for this behavior was proposed in terms of the microstructural anisotropy of the coatings coupled with the internal stress acting within the test surface. Scanning electron microscopy, transmission electron microscopy, and X-ray diffraction studies of coating morphology, grain size, defect density, and texture were performed and the results obtained used to estimate the relative contributions of grain size and defect density to coating hardness using a simple Hall-Petch approach. Author

N88-17799# Argonne National Lab., Ill.

MODELS FOR IONIC TRANSPORT IN GLASS

J. N. Mundy 1987 16 p Presented at the 6th International Conference on Solid State Ionics, Garmisch-Partenkirchen, Fed. Republic of Germany, 6 Sep. 1987 Prepared in cooperation with Max-Planck-Institut fuer Metallforschung, Stuttgart, Fed. Republic of Germany

(Contract W-31-109-eng-38)

(DE88-002860; CONF-8709116-6) Avail: NTIS HC A03/MF A01

A satisfactory model for ionic transport in glass proves elusive. The apparent success of the weak electrolyte theory in interpreting a number of the electrical properties is shown to be illusory as the same evidence provides an equally satisfactory justification for regarding glasses as highly defected solids. Evidence other than ionic transport measurements is introduced to show that there are more alkali ion sites than alkali ions in a glass. The overall weight of evidence suggests it is appropriate to interpret ionic transport in glass on the basis of a high defect concentration model. DOE

N88-17800# Argonne National Lab., Ill.

NMR (NUCLEAR MAGNETIC RESONANCE) IMAGING FOR DETECTING BINDER/PLASTICIZERS IN GREEN-STATE STRUCTURAL CERAMICS

W. A. Ellingson, J. L. Ackerman, S. Gronemeyer, and L. Garrido Jun. 1987 19 p Presented at the 16th Symposium on Nondestructive Evaluation, San Antonio, Tex., 21 Apr. 1987 Prepared in cooperation with Massachusetts General Hospital, Boston; Siemens Medical Systems, St. Louis, Mo.

(Contract W-31-109-eng-38)

(DE88-003111; CONF-8704231-2) Avail: NTIS HC A03/MF A01

We have explored both a small-bore (less than 10 cm) experimental imaging system as well as a state-of-the-art medical imaging system relative to detection of the soft-solid (wax-like) binders used in ceramics. The ability to detect binders was evaluated on a 1.5-T medical proton nuclear magnetic resonance imager (MRI) imager (Siemens Magnetom) using T sub 1- weighted imaging techniques and a 10-cm eye coil standard with the system. The ability to detect binders was also studied with a modified

small-bore coil Technicare Facility using special RF and gradient coils. The initial results show that a medical system may not be able to detect binders unless elevated temperatures are used, whereas the experimental small-bore system shows the distribution quite well. In addition, higher magnetic field strength should be better for ceramics, since proton signal strength increases rapidly with the magnetic field strength. DOE

N88-17801*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.
ADHESION, FRICTION AND MICROMECHANICAL PROPERTIES OF CERAMICS
Kazuhisa Miyoshi 1988 24 p Proposed for presentation at the 15th International Conference on Metallurgical Coatings, San Diego, Calif., 11-15 Apr. 1988; sponsored by American Vacuum Society
(NASA-TM-100782; E-3954; NAS 1.15:100782) Avail: NTIS HC A03/MF A01 CSCL 11C

The adhesion, friction, and micromechanical properties of ceramics, both in monolithic and coating form, are reviewed. Ceramics are examined in contact with themselves, other harder materials, and metals. For the simplicity of discussion, the tribological properties of concern in the processes are separated into two parts. The first part discusses the pull-off force (adhesion) and the shear force required to break the interfacial junctions between contacting surfaces. The role of chemical bonding in adhesion and friction, and the effects of surface contaminant films and temperature on tribological response with respect to adhesion and friction are discussed. The second part deals with abrasion of ceramics. Elastic, plastic, and fracture behavior of ceramics in solid state contact is discussed. The scratch technique of determining the critical load needed to fracture interfacial adhesive bonds of ceramic deposited on substrates is also addressed. Author

N88-17802*# National Materials Advisory Board, Washington, D. C.
TRIBOLOGY OF CERAMICS: REPORT OF THE COMMITTEE ON TRIBOLOGY OF CERAMICS
1988 117 p Sponsored in part by NASA, Washington, D.C.
(Contract MDA903-86-K-0220)
(NASA-CR-182506; NAS 1.26:182506; NMAB-435) Avail: NTIS HC A06/MF A01 CSCL 11B

The current state of knowledge of ceramic surface structures, composition, and reactivity is reviewed. The tribological requirements of advanced mechanical systems now being deployed (in particular, heat engines) exceed the capabilities of traditional metallic-based materials because of the high temperatures encountered. Advanced ceramic materials for such applications are receiving intense scrutiny, but there is a lack of understanding of the properties and behavior of ceramic surfaces and the influence of processing on the properties of ceramics is described. The adequacy of models, ranging form atomic to macro, to describe and to predict ceramic friction and wear are discussed, as well as what is known about lubrication at elevated temperatures. From this analysis, recommendations are made for coordination, research, and development that will lead to better performance of ceramic materials in tribological systems. Author

N88-17803*# National Aeronautics and Space Administration, Washington, D.C.
ELECTRICALLY CONDUCTING POLYMER-COPPER SULPHIDE COMPOSITE FILMS, PREPARATION BY TREATMENT OF POLYMER-COPPER (2) ACETATE COMPOSITES WITH HYDROGEN SULFIDE
Takakazu Yamamoto, Takahira Kamigaki, and Etsuo Kubota Mar. 1988 8 p Transl. into ENGLISH from Kobunshi Ronbunshu (Japan), v. 44, no. 4, Apr. 1987 p 327-329 Transl. by Scientific Translation Service, Santa Barbara, Calif.
(Contract NASw-4307)
(NASA-TT-20204; NAS 1.77:20204) Avail: NTIS HC A02/MF A01 CSCL 11B

Polymer copper sulfide composite films were prepared by treatment of polymer poly(vinyl chloride), poly(acrylonitrile), copolymer of vinyl chloride and vinyl acetate (90:10), and ABS resin copper (2) acetate composites with hydrogen sulfide. The films showed electrical conductivity higher than 0.015 S/cm when they contained more than 20 wt percent of copper sulfide. A poly(acrylonitrile)-copper sulfide composite film containing 40 to 50 wt percent of copper sulfide showed electrical conductivity of 10 to 150.0 S/cm and had relatively high mechanical strength to be used in practical purposes. Author

N88-17804# Integral Technologies, Inc., Westmont, Ill.
EFFECT OF TRANSLUCENCE OF ENGINEERING CERAMICS ON HEAT TRANSFER IN DIESEL ENGINES Final Report
S. Wahiduzzaman and T. Morel Oct. 1987 88 p
(Contract DE-AC05-84OR-21400)
(DE88-003732; ORNL/Sub-86-22042/1) Avail: NTIS HC A05/MF A01

This report addresses the question of translucence of ceramics, and investigates how it influences the net heat transfer to the engine structure. A two flux radiation model was developed to describe radiation within the ceramic, and it was checked and validated against accurate literature results. Based on it, a coupled radiation/conduction model of a ceramic was developed, and it was used in conjunction with time-dependent boundary conditions describing gas-phase heat transfer arising in a heavy duty truck engine operating at its rated point. The model was applied to limiting cases of fully opaque and full transparent materials, and also in a parametric study covering a wide range of ceramic radiative properties encompassing the range of such properties considered possible for heat barrier ceramics. The material thickness and conductivity were varied as well. The results showed that translucence can have significant detrimental effects on heat barrier effectiveness under realistic diesel engine conditions. The most important properties are the absorption and scattering coefficients of the ceramics. As these become less opaque, the total heat flux through the ceramic layer increases. For low conductivity ceramics this increase can amount to 50 percent and more. Significant effects begin to be felt for absorption coefficients smaller than 10,000/m and scattering coefficients smaller than 20,000/m. An important parameter is also the heat barrier thermal conductance, i.e., the ratio of thermal conductivity to the layer thickness. It is recommended that radiative properties be among the properties that are measured and reported for ceramic materials. If a particular ceramic is found too translucent, some tailoring of its radiative properties, e.g., by additives, should be considered. DOE

N88-17805# Brown Univ., Providence, R. I. Div. of Engineering.
BASIC RESEARCH ON MACROMOLECULAR DYNAMICS Annual Report, 1 Jun. 1986 - 31 May 1987
J. H. Weiner Jun. 1987 21 p
(Contract GRI-5085-260-1152)
(PB88-141643; GRI-87/0216) Avail: NTIS HC A03/MF A01 CSCL 11C

Three principal problem areas have been investigated: (1) the virial stress formulation has been applied to rubber-like materials and has been shown to provide valuable physical insight into the nature of stress in such systems; (2) molecular dynamics of a model corresponding to the three-chain model of rubber elasticity, with inter- as well as intrachain excluded volume interactions, has revealed density-dependent departures from the usual ideal chain results; and (3) these simulations also have revealed significant excluded-volume effects upon bond orientation in rubber-like materials undergoing uniaxial deformation. GRA

N88-17806# Pennsylvania State Univ., University Park. Materials Research Lab.
MECHANISMS OF WEAR IN SINGLE- AND TWO-PHASE MATERIALS Final Report
N. H. Macmillan Nov. 1987 224 p
(Contract DE-AC02-82ER-12037)

(DE88-003846; DOE/ER-12037/2) Avail: NTIS HC A10/MF A01

A comparative study has been made of the rolling-tumbling-sliding wear and solid particle erosion behavior of four single-phase materials (Cu, Pb, Al2O3, a lead borosilicate glass), and a series of ductile-ductile (Pb-Cu), ductile-brittle (Pb-Al2O3), brittle-ductile (glass-Cu), and brittle-brittle (glass-Al2O3) composites prepared from them. The same irregularly shaped 600 micron WC-8 wt. percent Co abrasive particles were used throughout this work. Additional erosion measurements have been made on Danto Koruntz, Abresist, and sintered alpha-SiC, using similar particles. Some subtle influences of erosive particle wear are documented for the first time, and the inadequacy of the currently available theoretical models to describe the influence of microstructure on erosion is exposed. DOE

N88-17807# Utah Univ., Salt Lake City. Dept. of Materials Science and Engineering.

FABRICATION, PHASE TRANSFORMATION STUDIES AND CHARACTERIZATION OF SiC-AlN-Al2OC CERAMICS

A. V. Virkar 1987 19 p

(Contract DE-FG02-87ER-45286)

(DE88-004053; DOE/ER-45286/1) Avail: NTIS HC A03/MF A01

Work has progressed in three principal areas. These are: (1) phase transformation in SiC-AlN ceramics, (2) phase equilibria and transformation in AlN-Al sub 2 OC ceramics, (3) and elevated temperature creep in SiC-AlON ceramics and AlN. Principal characterization tools for the study of phase equilibria and transformation have been high resolution electron microscopy, microchemical analysis, optical microscopy and X-ray diffraction. DOE

N88-17808# Cornell Univ., Ithaca, N.Y. Dept. of Materials Science and Engineering.

THE MIGRATION OF GRAIN BOUNDARIES IN CERAMIC MATERIALS WITH PARTICULAR REFERENCE TO THE SINTERING PROCESS Progress Report, 15 Nov. 1986 - 14 Nov. 1987

C. B. Carter Nov. 1987 8 p

(Contract DE-FG02-84ER-45092)

(DE88-004085; DOE/ER-45092/T3) Avail: NTIS HC A02/MF A01

The purpose is to understand how the structure and chemistry of grain boundaries influence the sintering and densification of polycrystalline ceramic materials. The study has been limited to alumina, spinel and germanium. This choice of materials allows effects associated with a particular type of crystal structure of interatomic bonding to be distinguished from effects which are common to all ceramic materials. The following lines of work have been followed: The analysis of surfaces of alumina has been extended to other materials. The faceting of alumina/glass interfaces has been continued. The first alumina bicrystals have been prepared using the new Centaur (2000 C) hot-press. A method for quantifying grain growth in NiO thin films is being developed. On high-Tc materials, we have been involved in some exploratory work on the grain boundary structures present in thin films. The following topics are now being considered: application of the O-lattice, the coincident-site lattice (CSL) and DSC lattice concepts to ceramic systems; we are continuing our analysis of thin amorphous phases in grain boundaries using HREM image simulation; and the relation between surfaces, grain boundaries, pores and sintering. DOE

N88-17809# Brookhaven National Lab., Upton, N. Y.

THERMOGRAVIMETRIC ANALYSIS OF POLYMERIC MATERIALS FOR AN INTERMEDIATE TEMPERATURE SOLID ELECTROLYTE

C. A. Linkous and T. Wade Oct. 1987 73 p

(Contract DE-AC02-76CH-00016)

(DE88-004854; BNL-40547) Avail: NTIS HC A04/MF A01

Weight-loss thermograms under atmospheres of N sub 2, H sub 2, and O sub 2 were taken for 39 polymeric candidate materials for use in an intermediate temperature (300 to 600 C) electrolyte. Selected materials were also tested under a steam atmosphere. The following materials showed sufficient stability as to warrant further study: polyimide; polyamide; polymers of pyrrolidone, pyridine, and imidazoline; phthalocyanine; polyethylene glycol and polyvinylmethyl ether. Polyacrylonitrile and polyphenylene sulfide, while exhibiting a limited performance here, show enough potential that further attention should be given to them also. Studies on the stability of various ionomers indicated that simple acidic oxo-anions such as sulfonate and carbonate are unsuitable for use as proton binding sites in the desired temperature range. DOE

N88-17810# Maine Univ., Orono. Lab. for Surface Science and Technology.

ADHESION OF VAPOUR PHASE DEPOSITED ULTRA-THIN POLYIMIDE FILMS ON POLYCRYSTALLINE SILVER

R. N. Lamb and M. Grunze 10 Nov. 1987 58 p

(Contract N00014-85-K-0641)

(AD-A187930; TR-6) Avail: NTIS HC A04/MF A01 CSCL 11I

The vapor phase deposition of 4,4 Oxydianiline (ODA) and Pyromellitic dianhydride (PMDA) on a polycrystalline silver substrate was studied using X-ray photoelectron spectroscopy. Adsorption of the pure components on the clean substrate at room temperature results in partial fragmentation of the adsorbate molecules. Bonding to the silver is believed to occur via the oxygens in the ODA and PMDA fragments. Room temperature codeposition of PMDA and ODA in a thin (-36 A) layer, followed by heating, led to polymerization and the formation of an ultra-thin (-11 A) and thermally stable (T leas than 450 C) polyimide film. Adhesion of this polymer involves chemical bonding to the fragments of PMDA and ODA initially chemisorbed on the surface. These experiments demonstrate that sufficiently thin polymerized films can be prepared and applied to fundamental studies of adhesion. GRA

N88-17840# Messerschmitt-Boelkow-Blohm G.m.b.H., Ottobrunn (West Germany). Abteilung Technologie-Entwicklung.

NEW SCIENTIFIC FINDINGS ON THE MORPHOLOGY OF ALUMINUM OXIDE LAYERS, SERVING AS AN ADHESIVE BASIS [NEUE ERKENNTNISSE UEBER DIE MORPHOLOGIE VON ALUMINIUMOXIDSCHICHTEN, DIE ALS KLEBEGRUNDLAGE DIENEN]

Harald Dengler, Horst E. Franz, and Felix Nitschke *In its* Research and Development. Technical-Scientific Publications (1956-1987): Retrospective View and Prospects. Jubilee Edition on the Occasion of the 75th Anniversary of Dipl.-Engr. Dr.-Engr. E.H. Ludwig Boelkow 1987 p 135-140 In GERMAN (For primary document see N88-17819 10-31)

(MBB-Z-137/86) Copyright Avail: NTIS HC A14/MF A01

28 PROPELLANTS AND FUELS

Includes rocket propellants, igniters, and oxidizers; their storage and handling procedures; and aircraft fuels.

For related information see also *07 Aircraft Propulsion and Power, 20 Spacecraft Propulsion and Power,* and *44 Energy Production and Conversion.*

N88-17811# Department of Energy, Washington, D. C. Office of Energy Storage and Distribution.

HYDROGEN ENERGY COORDINATING COMMITTEE: SUMMARY OF DOE HYDROGEN PROGRAMS FOR FY 1987 Annual Report

Jan. 1988 44 p

(DE88-003960; DOE/CE-0201) Avail: NTIS HC A03/MF A01

The HECC (Hydrogen Energy Coordinating Committee) was organized to improve communications between various groups performing research related to hydrogen. The FY 1987 summary is the tenth consecutive yearly report providing an overview of the hydrogen-related programs of the DOE offices represented on the HECC. These offices include Basic Energy Sciences, Energy Storage and Distribution, Fossil Energy, Fusion Energy, Inertial

Fusion, Military Application, Solar Energy, and Transportation Systems. DOE

N88-17812# Argonne National Lab., Ill.
THE CHEMISTRY OF THE HYPOCHLORITE NEUTRALIZATION OF HYDRAZINE FUELS
K. L. Brubaker 1987 11 p Presented at the 3rd Conference on the Environmental Chemistry of Hydrazine Fuels, Panama City, Fla., 15 Sep. 1987
(Contract W-31109-eng-38)
(DE88-002971; CONF-8709201-1) Avail: NTIS HC A03/MF A01

Neutralization of hydrazine fuels with hypochlorite is a recommended procedure for the treatment of fuel spills prior to disposal. Various research workers have shown, however, that incomplete reaction of hypochlorite with the methylated hydrazine fuels monomethylhydrazine and unsymmetrical dimethylhydrazine leads to a wide variety of byproducts, including N-nitrosoalkylamines. The known reaction products and mechanisms are reviewed and summarized. DOE

N88-17813# Chevron Research Co., Richmond, Calif.
HIGH-DENSITY JET FUELS FROM COAL SYNCRUDES, APPENDIX 4
R. F. Sullivan 1987 12 p Presented at the 193rd National Meeting of the American Chemical Society, Denver, Colo., 5 Apr. 1987
(Contract DE-AC22-76ET-10532)
(DE88-003132; CONF-870410-40-App-4) Avail: NTIS HC A03/MF A01

Very dense jet-boiling-range hydrocarbons can be obtained by hydrotreating and hydrocracking syncrudes made from coal in direct liquefaction processes. Heteroatom impurities must be removed, and most of the aromatics must be hydrogenated at high severity in order to produce kerosene jet fuels from coal syncrudes that meet smoke point and stability specifications. The resulting hydrotreated products consist mainly of naphthenes containing from one to three rings. If hydrocracking is added as a conversion step, some four-ring naphthenes are found in the 250 to 550 F jet fuel products. Polycyclic naphthenes are desirable components for jet fuel because of their high volumetric energy contents and low freezing points. Products from the ITSL liquefaction process from bituminous coal had the lowest paraffin contents and the highest densities (for a given boiling range and aromatic content) of any of the coal liquids studied. Actual engine tests, however, would be needed to demonstrate that these fuels qualify for service in jet aircraft. DOE

N88-17814# Los Alamos National Lab., N. Mex.
EXPLO: EXPLOSIVES THERMAL ANALYSIS COMPUTER CODE
D. L. Jaeger and A. S. Vigil Oct. 1987 41 p
(Contract W-7405-eng-36)
(DE88-001938; LA-6949-MS-Rev-2) Avail: NTIS HC A03/MF A01

The finite difference method is used to calculate temperature fields and times to initiation for explosive materials. The code is one-dimensional and is programmed for Cartesian, cylindrical, and spherical coordinates. Temperature-dependent properties, phase changes, and multiple heat source terms are allowed. Multiple source terms use Nth-order Arrhenius kinetics for each material component. Temperature, flux, convection, or radiation boundary conditions may be employed. Internal convection is considered for materials that undergo a solid/liquid phase change. The Crank-Nicholson implicit solution method, which allows large time steps and short running time, is used. DOE

N88-17815# Ballistic Research Labs., Aberdeen Proving Ground, Md.
AN INFRA-RED INVESTIGATION OF HAN (HYDROXYLAMMONIUM NITRATE)-BASED LIQUID PROPELLANTS
Nathan Klein and Koon N. Wong Jun. 1987 49 p
(AD-A187226; BRL-TR-2850) Avail: NTIS HC A03/MF A01 CSCL 21I

This report deals with the use of Fourier transform infrared spectroscopy (FTIR) for study of the hydroxylammonium nitrate (HAN), aqueous liquid propellants. Several subjects are addressed. The feasibility of total assay of propellant, involving the simultaneous analysis of all of the components is demonstrated. A quantitative method for determination of HAN concentration that is suitable for continuous on-line use at a production facility is described. Finally, the structure of HAN-water mixtures as a function of concentration is explored in detail. HAN is highly soluble, producing homogeneous mixtures at room temperature with salt concentrations in excess of 16 mole/1. Changes in the vibrational spectra of all three components, HA(+), NO3(-), and water, provide a consistent picture of the interactions between these species. The nitrate spectrum is most sensitive to interactions between the species present because distinctive bands due to ion-pairing and hydration are observed. Changes in the nitrate spectrum characteristic of ion hydration are seen in dilute solution and, as concentration increases, features attributable to ion-pairs become evident and eventually dominate the spectra. The spectra of the other components provide evidence that the ion-paired species is strongly hydrogen bonded via the HA(+) O-H group. GRA

N88-17816# United Technologies Research Center, East Hartford, Conn.
INVESTIGATION OF REAL-TIME TWO-DIMENSIONAL VISUALIZATION OF FUEL SPRAY LIQUID/VAPOR DISTRIBUTION VIA EXCIPLEX FLUORESCENCE Final Report, 1 Jul. 1984 - 30 Jul. 1987
James F. Verdieck, Arthur A. Rotunno, and Lynn A. Melton 30 Aug. 1987 89 p Prepared in cooperation with Texas Univ., Dallas
(Contract DAAG29-84-C-0010)
(AD-A188268; UTRC/R87-956875-F; ARO-21132.4-EG) Avail: NTIS HC A05/MF A01 CSCL 21D

This final report describes the achievements of the research program carried out under the subject contract. The overall aim of the study was to develop a new and unique combustion diagnostic technique which would provide the real-time, two-dimensional visualization of both the liquid and vapor phase of a fuel spray by means of laser-induced exciplex fluorescence. Significant achievements toward this end were: (1) Demonstration and application of an exciplex thermometer, (2) Discovery of new exciplex systems, particularly intramolecular exciplex systems, (3) Formulation of a total scheme involving analysis of the exciplex spectral emissions for determining temperature, liquid and vapor concentrations, and the local oxygen pressure in the spray field, (4) Construction of an apparatus for studying single injected droplets into a controlled environment of temperature and pressure for observation of laser-induced exciplex fluorescence, (5) Modeling of single droplet vaporization in support of the experimental studies, (6) Observation of single droplet liquid and vapor phase fluorescence in two dimensions, and (7) Experiments toward achieving quantitative exciplex fluorescence measurements. GRA

29 MATERIALS PROCESSING

Includes space-based development of products and processes for commercial applications.

For biological materials see *55 Space Biology*.

N88-17817# Foersvarets Forskingsanstalt, Stockholm (Sweden).
RESULTS FROM THE MELTING OF TUNGSTEN COMPOSITES UNDER MICROGRAVITY (TEXUS 10 FLIGHT)
Lars Ekbom Sep. 1987 18 p
(PB88-128236; FOA-C-20676-2.1) Avail: NTIS HC A03/MF A01 CSCL 22A

A preliminary melting test with tungsten composites on a Texus 10 flight was done. The melting test shows that the system is of

interest for further investigations. The heavy tungsten particles floating in a matrix melt of nickel-iron grew very rapidly. They had an even distribution in the matrix after solidification. Author

N88-17818# Oak Ridge National Lab., Tenn.
AN EXPERIMENT TO INVESTIGATE RANKINE CYCLE TWO-PHASE MICROGRAVITY ISSUES
G. L. Yoder, Jr. and E. D. Brewer 1987 32 p Presented at the 4th Symposium on Space Nuclear Power Systems, Albuquerque, N. Mex., 12 Jan. 1987
(Contract DE-AC05-84OR-21400)
(DE88-004197; CONF-870102-30) Avail: NTIS HC A03/MF A01

An experiment is being developed to investigate two-phase flow and heat transfer behavior under the microgravity conditions of space. The experiment is designed to be carried out utilizing the NASA standard Get Away Special (GAS) canister to be flown on a future space shuttle flight. The experiment contains a full two phase flow boiling loop, and will determine the effect of microgravity conditions on nucleate boiling heat transfer and critical heat flux values as well as examine liquid/vapor separation processes. This paper describes the experiment designed to be flown on the shuttle as well as a similar ground test loop presently being operated. In addition, initial data from the ground system is presented. Data taken thus far in upflow show increasing critical heat values with increasing test section velocity and inlet subcooling. DOE

N88-17692*# Universidad Nacional Autonoma de Mexico, Mexico City.
MICROGRAVITY RESEARCH AT THE UNIVERSITY OF MEXICO: EXPERIMENTS IN PAYLOAD G-006
Ricardo Peralta-Fabi and Javier Mendieta-Jimenez (Instituto de Investigaciones Electricas, Palmira, Mexico) *In* NASA. Goddard Space Flight Center, The 1987 Get Away Special Experimenter's Symposium Feb. 1988 p 1-7 Sponsored by CONACYT and SCT, Mexico (For primary document see N88-17691 10-12)
Avail: NTIS HC A08/MF A01 CSCL 22A

N88-17696*# Deutsche Forschungs- und Versuchsanstalt fuer Luft- und Raumfahrt, Cologne (West Germany).
TEN PAST AND TEN FUTURE GAS/MAUS-PAYLOADS
S. Staniek, G. Otto, and J. Doepkess (Messerschmitt-Boelkow-Blohm G.m.b.H., Bremen, West Germany) *In* NASA. Goddard Space Flight Center, The 1987 Get Away Special Experimenter's Symposium Feb. 1988 p 31-38 (For primary document see N88-17691 10-12)
Avail: NTIS HC A08/MF A01 CSCL 22A

N88-17697*# Worcester Polytechnic Inst., Mass. Dept. of Electrical Engineering.
AN UPDATE TO THE MITRE/WPI SPACE SHUTTLE PROGRAM GASCAN G-408
F. J. Looft and W. D. Durgin *In* NASA. Goddard Space Flight Center, The 1987 Get Away Special Experimenter's Symposium Feb. 1988 p 39-46 (For primary document see N88-17691 10-12)
Avail: NTIS HC A08/MF A01 CSCL 22A

N88-17698*# National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, Md.
ELECTROCHEMICAL GROWTH OF LINEAR CONDUCTING CRYSTALS IN MICROGRAVITY
Raymond J. Cronise, IV *In its* The 1987 Get Away Special Experimenter's Symposium Feb. 1988 p 47-53 Sponsored in part by Westinghouse Electric Corp., Baltimore, Md. (For primary document see N88-17691 10-12)
Avail: NTIS HC A08/MF A01 CSCL 22A

N88-17700*# Fujitsu Ltd., Atsugi (Japan).
PROTEIN-CRYSTAL GROWTH EXPERIMENT (PLANNED)
S. Fujita, K. Asano, T. Hashitani, T. Kitakohji, H. Nemoto, and S. Kitamura (Fujitsu Ltd., Kwasaki, Japan) *In* NASA. Goddard Space Flight Center, The 1987 Get Away Special Experimenter's Symposium Feb. 1988 p 63-68 (For primary document see N88-17691 10-12)
Avail: NTIS HC A08/MF A01 CSCL 22A

N88-17703*# Swedish Space Corp., Stockholm.
AN ADVANCED MICROCOMPUTER DESIGN FOR PROCESSING OF SEMICONDUCTOR MATERIALS
L. Bjoern, L. Lindkvist, and J. Zaar *In* NASA. Goddard Space Flight Center, The 1987 Get Away Special Experimenter's Symposium Feb. 1988 p 83-88 (For primary document see N88-17691 10-12)
Avail: NTIS HC A08/MF A01 CSCL 22A

N88-17704*# Tohoku Univ., Sendai (Japan). Faculty of Science.
APPLICATION OF HOFFMAN MODULATION CONTRAST MICROSCOPY COUPLED WITH THREE-WAVELENGTH TWO-BEAM INTERFEROMETRY TO THE IN SITU DIRECT OBSERVATION OF THE GROWTH PROCESS OF A CRYSTAL IN MICROGRAVITY
Katsuo Tsukamoto *In* NASA. Goddard Space Flight Center, The 1987 Get Away Special Experimenter's Symposium Feb. 1988 p 89-98 (For primary document see N88-17691 10-12)
Avail: NTIS HC A08/MF A01 CSCL 22A

N88-17705*# Orbital Systems Ltd., Lanham, Md.
THE CHALLENGE OF G-376
George L. Dorsey *In* NASA. Goddard Space Flight Center, The 1987 Get Away Special Experimenter's Symposium Feb. 1988 p 99-105 (For primary document see N88-17691 10-12)
Avail: NTIS HC A08/MF A01 CSCL 22A

N88-17707*# Redstone Scientific Information Center, Redstone Arsenal, Ala.
PROJECT EXPLORER TAKES ITS SECOND STEP: GAS-608 IN ENGINEERING DEVELOPMENT
Philip H. Kitchens *In* NASA. Goddard Space Flight Center, The 1987 Get Away Special Experimenter's Symposium Feb. 1988 p 115-119 (For primary document see N88-17691 10-12)
Avail: NTIS HC A08/MF A01 CSCL 22A

N88-17708*# California State Polytechnic Coll., San Luis Obispo. Space Project.
A RELIABLE DATA COLLECTION/CONTROL SYSTEM
Thom Maughan *In* NASA. Goddard Space Flight Center, The 1987 Get Away Special Experimenter's Symposium Feb. 1988 p 121-126 (For primary document see N88-17691 10-12)
Avail: NTIS HC A08/MF A01 CSCL 22A

N88-17709*# American Inst. of Aeronautics and Astronautics, New York, N.Y.
GAS 450: A SPACE PAYLOAD FOR THE PEOPLE CENTRAL COAST STUDENT EXPERIMENTERS
Glen Ray *In* NASA. Goddard Space Flight Center, The 1987 Get Away Special Experimenter's Symposium Feb. 1988 p 127-132 (For primary document see N88-17691 10-12)
Avail: NTIS HC A08/MF A01 CSCL 22A

N88-17712*# National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, Md.
GAS ELEVEN NODE THERMAL MODEL (GEM)
Dan Butler *In its* The 1987 Get Away Special Experimenter's Symposium Feb. 1988 p 147-169 (For primary document see N88-17691 10-12)
Avail: NTIS HC A08/MF A01 CSCL 22A

N88-17856# Messerschmitt-Boelkow-Blohm G.m.b.H., Ottobrunn (West Germany). Unternehmensgruppe Raumfahrt.
THE PROSPECTS OF SPACE UTILIZATION [PERSPEKTIVEN DER WALTRAUMNUTZUNG]
Othmar Heise *In its* Research and Development. Technical-Scientific Publications (1956-1987): Retrospective View and Prospects. Jubilee Edition on the Occasion of the 75th Anniversary of Dipl.-Engr. Dr.-Engr. E.H. Ludwig Boelkow 1987

p 241-250 In GERMAN (For primary document see N88-17819 10-31)
(MBB-UR-931/86; BDI-187) Copyright Avail: NTIS HC A14/MF A01

31 ENGINEERING (GENERAL)

Includes vacuum technology; control engineering; display engineering; cryogenics; and fire prevention.

N88-17819# Messerschmitt-Boelkow-Blohm G.m.b.H., Ottobrunn (West Germany). Zentralbereich Technik.
RESEARCH AND DEVELOPMENT. TECHNICAL-SCIENTIFIC PUBLICATIONS (1956-1987): RETROSPECTIVE VIEW AND PROSPECTS. JUBILEE EDITION ON THE OCCASION OF THE 75TH BIRTHDAY OF DIPL.-ENGR. DR.-ENGR. E. H. LUDWIG BOELKOW [FORSCHUNG UND ENTWICKUNG. TECHNISCH-WISSENSCHAFTLICHE VEROEFFENTLICHUNGEN 1956-1987 EIN RUECK- UND AUSBLICK. JUBILAEUMSAUSGABE ANALAESSLICH DES 75 GEBURTSTAGES VON DIPL.-ING DR.-ING. E. H. LUDWIG BOELKOW]
1987 319 p Partly in GERMAN and ENGLISH
(ISSN-0931-9751; ETN-88-91025) Copyright Avail: NTIS HC A14/MF A01

Fighter aircraft, transport aircraft, helicopters, astronautics, and military techniques are discussed. For individual titles, see N88-17820 through N88-17868.

N88-17820# Messerschmitt-Boelkow-Blohm G.m.b.H., Ottobrunn (West Germany).
RESEARCH, DEVELOPMENT, AND GROWTH STRATEGY [FORSCHUNG, ENTWICKLUNG UND WACHSTUMSSTRATEGIE] **c81**
Ludwig Boelkow *In its* Research and Development. Technical-Scientific Publications (1956-1987): Retrospective View and Prospects. Jubilee Edition on the Occasion of the 75th Anniversary of Dipl.-Engr. Dr.-Engr. E.H. Ludwig Boelkow 1987 p 19-24 In GERMAN Presented at the 6th Conseil International de l'Organisation Scientifique European Congress, Cannes, France, 25 Nov. 1968 (For primary document see N88-17819 10-31)
Copyright Avail: NTIS HC A14/MF A01

The effects of research and development on the growth strategy of an industrial company are analyzed. The concepts research, development, technology, and thinking in terms of a global system are depicted. The conditions required for research and development in a company are given. The organization and management of research and development within an industrial company are described. ESA

N88-17821# Boelkow-Entwicklingen K.G., Stuttgart (West Germany). Entwicklungsabteilung Mathematik.
BOUNDARY LAYER CALCULATION USING DIGITAL COMPUTERS [GRENZSCHICHTBERECHNUNG MIT DIGITALEN RECHENAUTOMATEN] **c34**
Richard Eppler *In* MBB GmbH, Research and Development. Technical-Scientific Publications (1956-1987): Retrospective View and Prospects. Jubilee Edition on the Occasion of the 75th Anniversary of Dipl.-Engr. Dr.-Engr. E.H. Ludwig Boelkow 1987 p 25-32 In GERMAN (For primary document see N88-17819 10-31)
(Rept-MM-4) Copyright Avail: NTIS HC A14/MF A01

Incompressible, two-dimensional, laminar and turbulent boundary layers were calculated using the IBM 650 computer. The basic equations are presented. The momentum and energy laws for a so-called single parameter solution were used. For the numerical integration of the differential equations, a computer program was developed using a simplified Runge method. An instability occurring in the numerical method, and its stabilization are discussed. The program allows the easy computation of boundary layers. A comparison of results with other theories and experiments shows that the preliminary calculation of boundary layers for practical applications is possible, and that the empirical relations governing turbulent boundary layers can be checked in a more comprehensive way than before. ESA

N88-17822# Entwicklungsring Sud, Munich (West Germany). Projektabteilung.
DEVELOPMENT OF VERTICAL TAKEOFF AIRCRAFT WITH TURBOJET ENGINES IN GERMANY [DIE ENTWICKLUNG VON SENKRECHTSTARTFLUGZEUGEN MIT TURBINENSTRAHL-TRIEBWERKEN IN DEUTSCHALND **c05**
Karl Schwaerzler *In* MBB GmbH, Research and Development. Technical-Scientific Publications (1956-1987): Retrospective View and Prospects. Jubilee Edition on the Occasion of the 75th Anniversary of Dipl.-Engr. Dr.-Engr. E.H. Ludwig Boelkow 1987 p 33-40 In GERMAN (For primary document see N88-17819 10-31)
Copyright Avail: NTIS HC A14/MF A01

The history of the development of vertical takeoff aircraft with turbojet engines in Germany is depicted. The different engine arrangements used in VTOL aircraft are described. The different designs for the tilting of the engine nacelle are discussed. The thrust control and stabilization of VTOL aircraft are explained, and test methods are described. The effects of the soil on VTOL aircraft are outlined. The test aircraft X1 and the aircraft VJ101C are described. ESA

N88-17823# Entwicklungsring Sud, Munich (West Germany). Projektabteilung.
VARIABLE SWEEP WINGS [VARIABLE PFEILUNG DES FLUEGELS] **c05**
Helmut Langfelder *In* MBB GmbH, Research and Development. Technical-Scientific Publications (1956-1987): Retrospective View and Prospects. Jubilee Edition on the Occasion of the 75th Anniversary of Dipl.-Engr. Dr.-Engr. E.H. Ludwig Boelkow 1987 p 41-46 In GERMAN Presented at the 6th Europaeischen Luftfahrtkongress, Munich, Fed. Republic of Germany, 1-4 Sep. 1965 (For primary document see N88-17819 10-31)
Copyright Avail: NTIS HC A14/MF A01

The adaptation of the aircraft form to the use of variable sweep wings is treated. The use of variable sweep wings results in a possible increase of the aerodynamic lift for takeoff and landing, and a simultaneous optimization of the maximum flight range at all speeds, and hence in a substantial improvement of the payload-range characteristics. Variable sweep wings also allow an improved maneuverability at low speed and a remarkable flight comfort. Although variable sweep wings are heavier, the aircraft can be smaller and more efficient. ESA

N88-17824# Deutsche Airbus G.m.b.H., Munich (West Germany). Technische Geschaeftsfuehrung.
THE EUROPEAN AIRBUS A-300 [DER EUROPAEISCHE AIRBUS A 300] **c05**
Hans Wocke *In* MBB GmbH Research and Development. Technical-Scientific Publications (1956-1987): Retrospective View and Prospects. Jubilee Edition on the Occasion of the 75th Anniversary of Dipl.-Engr. Dr.-Engr. E.H. Ludwig Boelkow 1987 p 47-50 In GERMAN Presented at the WGLR/DGRR-Jahrestagung, Karlsruhe, Fed. Republic of Germany, Oct. 1967 (For primary document see N88-17819 10-31)
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The aims of the European Airbus are given. The main characteristics of the A-300 aircraft are discussed. The main requirements which determine the aircraft are presented. The operational data of the A-300 aircraft are given. ESA

N88-17825# Messerschmitt-Boelkow-Blohm G.m.b.H., Ottobrunn (West Germany). Projektabteilung.
SPECIAL FLIGHT MECHANICAL FEATURES OF THE BESONDERHEITEN DES GELENKLOSEN HUBSCHRAUBER-ROTORS] **c05**
Guenter Reichert *In its* Research and Development. Technical-Scientific Publications (1956-1987): Retrospective View

and Prospects. Jubilee Edition on the Occasion of the 75th Anniversary of Dipl.-Engr. Dr.-Engr. E.H. Ludwig Boelkow 1987 p 51-58 In GERMAN Presented at the 6th WGLR Europaeischen Luftfahrtkongress, Munich, Fed. Republic of Germany, 1-4 Sep. 1965 (For primary document see N88-17819 10-31)
(MBB-FM-315/O) Copyright Avail: NTIS HC A14/MF A01

Features of a bearingless helicopter rotor resulting from the fact that substantially higher moments can be reached than with a normal rotor, thereby changing the flight characteristics, i.e., control as well as stability characteristics, are discussed. The control time behavior is substantially improved by the higher damping, and, simultaneously, control efficiency is enhanced. Rotor gust sensitivity is increased by the introduction of a bearingless blade connection, imposing extreme care in the design of the stiffness of blade connection and rotor blades. ESA

N88-17826# Bolkow Entwicklungen K. G., Munich (West Germany). Entwicklungsfachabteilung Triebwerke.
ROCKET AND AIRJET PROPULSION FOR BALLISTIC AND AERODYNAMIC SPACE PROBES [RAKETEN- UND LUFTSTRAHLANTRIEBE FUER BALLISTISCHE UND AERODYNAMISCHE RAUMFLUGKOERPER] **c20**
Karl Stoeckel *In* MBB GmbH, Research and Development. Technical-Scientific Publications (1956-1987): Retrospective View and Prospects. Jubilee Edition on the Occasion of the 75th Anniversary of Dipl.-Engr. Dr.-Engr. E.H. Ludwig Boelkow 1987 p 59-64 In GERMAN Presented at the WGLR/DGRR-Jahrestagung, Berlin, Fed. Republic of Germany, 14-18 Sep. 1964 (For primary document see N88-17819 10-31)
(Rept-TR-527) Copyright Avail: NTIS HC A14/MF A01

Motor system designs for ballistic and aerodynamic return space probes are discussed. Rocket propulsion systems for space projects are illustrated by the Moon landing projects Saturn C1 and Saturn C5. The use of air breathing systems for the propulsion of space gliders is discussed; the characteristics of the different systems are given. The trajectory data of several systems are compared. ESA

N88-17827# Messerschmitt-Boelkow-Blohm G.m.b.H., Ottobrunn (West Germany). Unternehmensbereich Raumfahrt.
AZUR, THE FIRST GERMAN RESEARCH SATELLITE 625-A, 1964-1969 [AZUR - ERSTER DEUTSCHER FORSCHUNGSSATELLIT 625-A, 1964-1969] **c18**
Ernst Theunissen and Hans Fabian *In its* Research and Development. Technical-Scientific Publications (1956-1987): Retrospective View and Prospects. Jubilee Edition on the Occasion of the 75th Anniversary of Dipl.-Engr. Dr.-Engr. E.H. Ludwig Boelkow 1987 p 65-70 In GERMAN (For primary document see N88-17819 10-31)
Copyright Avail: NTIS HC A14/MF A01

The German satellite project AZUR is presented. The scientific purposes of the project are given. The significance of a national space program for the Federal Republic of Germany is explained. Industrial aspects of the project are outlined. The experiments performed in the framework of AZUR are summarized. ESA

N88-17828# Messerschmitt-Boelkow-Blohm G.m.b.H., Ottobrunn (West Germany). Space Div.
BALLISTIC SINGLE STAGE CARRIER VEHICLE (BETA): A SINGLE STAGE REUSABLE BALLISTIC SPACE SHUTTLE CONCEPT **c16**
Dietrich E. Koelle *In its* Research and Development. Technical-Scientific Publications (1956-1987): Retrospective View and Prospects. Jubilee Edition on the Occasion of the 75th Anniversary of Dipl.-Engr. Dr.-Engr. E.H. Ludwig Boelkow 1987 p 71-74 Presented at the 21st International Astronautical Congress, Konstanz, Fed. Republic of Germany, 4-10 Sep. 1970 (For primary document see N88-17819 10-31)
(MBB-UR-949/70) Copyright Avail: NTIS HC A14/MF A01

Single stage launch vehicles, and the facility of reusuable systems as an alternative space shuttle were evaluated. The philosophy, design features, and flight operations of the BETA design concept, that combines features of Saturn, Apollo, and LM, and that is based on known technology, are presented. A design example for minimum possible size shows a payload of 2T for a 200 km/28.5 deg arc orbit with a 130T launch weight. For a 10T payload, the launch mass is 350T. It is shown that, from the point of view of development cost and operational simplicity, the single stage ballistic concept is superior to other solutions, and is therefore of special importance for European space transportation economics. ESA

N88-17829# Boelkow-Entwicklingen K.G., Stuttgart (West Germany). Entwicklungsfachabteilung Flugmechanik.
DEPENDENCE OF THE EXPECTANCY OF HITTING ON THE NUMBER OF SPREAD SHOTS. DETERMINATION OF THE EXPECTANCY OF HITTING USING A SPREAD SALVO [ABHAENGIGKEIT DER TREFFERWAHRSCHEINLICHKEIT VON DER ANZAHL DER STREUSCHUESSE. ERMITTLUNG DER TREFFERWAHRSCHEINLICHKEIT MITTELS FAECHERSCHUSS] **c65**
Hans-George Knoche *In* MBB GmbH, Research and Development. Technical-Scientific Publications (1956-1987): Retrospective View and Prospects. Jubilee Edition on the Occasion of the 75th Anniversary of Dipl.-Engr. Dr.-Engr. E.H. Ludwig Boelkow 1987 p 75-78 In GERMAN (For primary document see N88-17819 10-31)
(Rept-FM6; Rept-FM24) Copyright Avail: NTIS HC A14/MF A01

The variation of the hitting probability of an antiaircraft missile (main projectile) with the number of spread shots was investigated. The hitting probability of the main shot is supposed to be Gaussian. It is supposed that the hitting distribution of the spread shots follows a given probability law. The hitting probability as a function of the number of spread shots is graphically represented. The hitting probability was determined using a spread salvo, consisting of a main projectile and a number of single projectiles forming a spread cone. Diagrams showing hit probability as a function of the spread parameters, the number of single projectiles, the spread plane radius, and target width, are presented. ESA

N88-17830# Boelkow-Entwicklingen K.G., Stuttgart (West Germany). Abteilung Triebwerke.
INVESTIGATION OF SEVERAL SPREAD SHOT CONDITIONS [UEBER DIE UNTERSUCHUNG VERSCHIEDENER BEZIEHUNGEN BEIM STREUSCHUSS] **c65**
Franz-R. Thomanek *In* MBB GmbH, Research and Development. Technical-Scientific Publications (1956-1987): Retrospective View and Prospects. Jubilee Edition on the Occasion of the 75th Anniversary of Dipl.-Engr. Dr.-Engr. E.H. Ludwig Boelkow 1987 p 79-86 In GERMAN (For primary document see N88-17819 10-31)
(Rept-TR-164) Copyright Avail: NTIS HC A14/MF A01

The effect of different spread shot conditions were studied in order to improve the results of a spread shot on the destruction prospects of defensive rockets. The general trajectory relations, valid in the collision point, are deduced. The errors involved in the measurement of coordinates of target and rockets are discussed. The apparent target and grid sizes are explained. The hit probability is deduced. The requirements for the guidance systems of a defensive missile are discussed. ESA

N88-17831# Boelkow-Entwicklingen K.G., Stuttgart (West Germany). Abteilung Flugmechanik.
DETERMINATION OF THE DRAG OF MISSILES WITH VARIABLE LATERAL ACCELERATION POSSIBILITY [ERMITTLUNG DER WIDERSTAENDE FUER FLUGKOERPER MIT VERAENDERTER SEITENBESCHLEUNIGUNGSMOEGLICHKEIT] **c02**
Otto E. Pabst *In* MBB GmbH, Research and Development. Technical-Scientific Publications (1956-1987): Retrospective View and Prospects. Jubilee Edition on the Occasion of the 75th Anniversary of Dipl.-Engr. Dr.-Engr. E.H. Ludwig Boelkow 1987 p 87-92 In GERMAN (For primary document see N88-17819 10-31)
(Rept-FM15) Copyright Avail: NTIS HC A14/MF A01

A design compromise between the two main aerodynamic constraints of missiles (low drag and lateral acceleration possibility) was studied. The aerodynamic lift and drag of delta wings are discussed. The selection parameters for missiles with a favorable performance are presented. The interference between fuselage and wings is outlined. The drag of selected missiles is deduced. ESA

N88-17832# Bolkow Entwicklungen K. G., Munich (West Germany). Entwicklungsfachabteilung Triebwerke.
CALCULATION AND DESIGN OF A RAMJET MISSILE [BERECHNUNG UND ENTWURF EINER STAUSTRAHLRAKETE] c15
Johannes Schubert *In* MBB GmbH, Research and Development. Technical-Scientific Publications (1956-1987): Retrospective View and Prospects. Jubilee Edition on the Occasion of the 75th Anniversary of Dipl.-Engr. Dr.-Engr. E.H. Ludwig Boelkow 1987 p 93-96 In GERMAN (For primary document see N88-17819 10-31)
(Rept-TR-500) Copyright Avail: NTIS HC A14/MF A01

The fundamentals for the design of a ramjet missile are treated. The chemical fundamentals of the solid rocket propellants used for ramjet missiles are outlined. The determination of the most favorable flying speed is discussed. The thermodynamic fundamentals (calculation of the solid propellant missile, calculation of the mixing procedure and the after burning in the pressure nozzle, and power calculation) are presented. The design specifications of the propulsion system are given. ESA

N88-17833# Messerschmitt-Boelkow-Blohm G.m.b.H., Ottobrunn (West Germany). Engineering and Manufacturing Div.
COOPERATION KNOW-HOW IN HIGH-TECH PRODUCTS c84
Horst Prem *In its* Research and Development. Technical-Scientific Publications (1956-1987): Retrospective View and Prospects. Jubilee Edition on the Occasion of the 75th Anniversary of Dipl.-Engr. Dr.-Engr. E.H. Ludwig Boelkow 1987 p 99-106 Presented at the Binational Conference on Asia-Pacific Dimensions of International Business: A Joint French-German Approach, Stuttgart, Fed. Republic of Germany, 16-17 Oct. 1986 Previously announced in IAA as A87-49966 (For primary document see N88-17819 10-31)
(MBB-Z-101/86) Copyright Avail: NTIS HC A14/MF A01

The international cooperation of the German aerospace industry in the field of high-technology products is reviewed. The rationale for cooperation is explained. The technology targets for production, design, development, and basic research within Europe, with a view to the realization of competitive programs, are presented. Examples of international cooperation are given in order to demonstrate that the aerospace industry is a key factor in the international cooperation between industrialized nations. ESA

N88-17834# Messerschmitt-Boelkow-Blohm G.m.b.H., Ottobrunn (West Germany). Zentralbereich Technik.
THE MATHEMATIZATION OF THE MILITARY SCIENCES [DIE MATHEMATISIERUNG DER KRIEGSWISSENSCHAFTEN] c64
Ottokar Pospischil *In its* Research and Development. Technical-Scientific Publications (1956-1987): Retrospective View and Prospects. Jubilee Edition on the Occasion of the 75th Anniversary of Dipl.-Engr. Dr.-Engr. E.H. Ludwig Boelkow 1987 p 107-110 In GERMAN (For primary document see N88-17819 10-31)
(MBB-Z-139/87) Copyright Avail: NTIS HC A14/MF A01

The introduction of mathematics in military sciences is treated. The duel equations of Lanchester (1914) are presented. The general duel equations are explained. The question of the optimum behavior or optimum strategy in military operations is discussed. An assumption for position-dependent duel equations, and a complete description of the tactics are presented. ESA

N88-17835# Messerschmitt-Boelkow-Blohm G.m.b.H., Ottobrunn (West Germany). Zentralbereich Technik.
OPERATIONS RESEARCH IN MANAGEMENT? [OPERATIONS RESEARCH IN DER UNTERNEHMENSFUEHRUNG?] c66
Guenther Itzelsberger *In its* Research and Development. Technical-Scientific Publications (1956-1987): Retrospective View and Prospects. Jubilee Edition on the Occasion of the 75th Anniversary of Dipl.-Engr. Dr.-Engr. E.H. Ludwig Boelkow 1987 p 111-114 In GERMAN (For primary document see N88-17819 10-31)
(MBB-Z-138/87) Copyright Avail: NTIS HC A14/MF A01

The application of operations research (OR) in management is treated. A model for the complex situations in the process of the forming of an opinion, and the embedding of a complex model in a planning process are discussed. The development of OR tools for management processes requires special methods. The emphasis is on the architecture that forms the basis for the planning of modern communication technology. The integration of interactive modules gives field-oriented aspects the chance to take part in the decision making, in the form of quantitative inputs. ESA

N88-17836# Messerschmitt-Boelkow-Blohm G.m.b.H., Hamburg (West Germany). Unternehmensgruppe Transport- und Verkehrsflugzeuge.
LIGHT ELECTRONIC CONTROL SYSTEM (LECOS): A PROPOSAL FOR A INTERCONNECTED ERROR-TOLERANT, OPTOELECTRONIC CONTROL SYSTEM [LECOS - EIN VORSCHLAG FUER EIN VERMASCHTES, FEHLERTOLERANTES, LICHTELEKTRONISCHES STEUERUNGSSYSTEM] c08
Hans-Joachim Wendt *In its* Research and Development. Technical-Scientific Publications (1956-1987): Retrospective View and Prospects. Jubilee Edition on the Occasion of the 75th Anniversary of Dipl.-Engr. Dr.-Engr. E.H. Ludwig Boelkow 1987 p 115-118 In GERMAN (For primary document see N88-17819 10-31)
(MBB-UT-004/87) Copyright Avail: NTIS HC A14/MF A01

A flight control system, based on optical waveguide technology, is presented. The system aims at the replacement of cables in fly-by-wire systems, at the consequent use of microprocessor techniques with bus and sensor technology, as well as at developments in actuators. ESA

N88-17837# Messerschmitt-Boelkow-Blohm G.m.b.H., Ottobrunn (West Germany). Abteilung Technologie, Forschung-Informations-/Mikrosysteme.
CALCULATION OF THE SPATIAL-TEMPORAL DEFORMATION OF LASER PULSES IN MULTIPLE SCATTERING [BERECHNUNG DER RAUM-ZEITLICHEN DEFORMATION VON LASERPULSEN BEI MEHRFACHSREUUNG] c36
Konrad Altmann *In its* Research and Development. Technical-Scientific Publications (1956-1987): Retrospective View and Prospects. Jubilee Edition on the Occasion of the 75th Anniversary of Dipl.-Engr. Dr.-Engr. E.H. Ludwig Boelkow 1987 p 119-126 In GERMAN (For primary document see N88-17819 10-31)
(MBB-Z-111/87) Copyright Avail: NTIS HC A14/MF A01

An analytical time-dependent scattering theory was developed for the study of laser pulse deformation in a scattering medium. The theory allows the calculation of the received scattering intensity in the form of a series expansion, and is of special importance for weak-to-medium scattering media. The theory was applied to the case of the single scattering phenomenon that dominates forward scattering, such as for the application of Nd lasers in the atmosphere. Agreement with the theory of Tam and Zardecki is demonstrated. The single terms of the series expansion can be calculated from a generalized set of functions for the complete forward scattering range; accuracy is better than with a Monte Carlo method. ESA

N88-17838# Messerschmitt-Boelkow-Blohm G.m.b.H., Ottobrunn (West Germany). Abteilung Technologie, Forschung-Informations-/Mikrosysteme.
THE MECHANISM OF ANISOTROPIC SILICON ETCHING AND ITS RELEVANCE FOR MICROMACHININGS
Helmut Seidel *In its* Research and Development. Technical-Scientific Publications (1956-1987): Retrospective View

and Prospects. Jubilee Edition on the Occasion of the 75th Anniversary of Dipl.-Engr. Dr.-Engr. E.H. Ludwig Boelkow 1987 p 127-130 Presented at the Fourth International Congress on Solid-State Sensors and Actuators-Transducers '87, Tokyo, Japan, 2-5 Jun. 1987 (For primary document see N88-17819 10-31)
(MBB-UA-1013/86) Copyright Avail: NTIS HC A14/MF A01

A consistent model for two silicon etching systems is presented to explain the phenomena of anisotropy and the boron-induced quasi-etch-stop. The first system is based on ethylenediamine and water, with additives like pyrocatechol and pyrazine; the second is based on purely inorganic alkaline solutions like KOH, NaOH, or LiOH. The etchants were experimentally characterized with respect to their dependence on crystal orientation and on boron dopant concentration of silicon. Based on these results, a model for the electrochemical etch mechanism is proposed. Suggestions as to which etchant composition serves best for a given application are given. ESA

N88-17839# Messerschmitt-Boelkow-Blohm G.m.b.H., Ottobrunn (West Germany). Abteilung Technologie-Entwicklungen.
MODERN MATERIALS FOR LIGHT CONSTRUCTIONS [MODERNE WERKSTOFFE FUER DEN LEICHTBAU] c05
Juergen Brandt, Helmut Kellerer, and Peter J. Winkler *In its* Research and Development. Technical-Scientific Publications (1956-1987): Retrospective View and Prospects. Jubilee Edition on the Occasion of the 75th Anniversary of Dipl.-Engr. Dr.-Engr. E.H. Ludwig Boelkow 1987 p 131-134 In GERMAN (For primary document see N88-17819 10-31)
(MBB-Z-136/86) Copyright Avail: NTIS HC A14/MF A01

Materials and materials technologies for the light construction of primary aircraft structural members are discussed. The cost criteria for the use of light materials are outlined. Materials characteristics used to evaluate applicability of each material are discussed. The properties and possible applications of fiber reinforced composites, fiber reinforced metals, and light alloys are presented. ESA

N88-17840# Messerschmitt-Boelkow-Blohm G.m.b.H., Ottobrunn (West Germany). Abteilung Technologie-Entwicklung.
NEW SCIENTIFIC FINDINGS ON THE MORPHOLOGY OF ALUMINUM OXIDE LAYERS, SERVING AS AN ADHESIVE BASIS [NEUE ERKENNTNISSE UEBER DIE MORPHOLOGIE VON ALUMINIUMOXIDSCHICHTEN, DIE ALS KLEBEGRUNDLAGE DIENEN] c27
Harald Dengler, Horst E. Franz, and Felix Nitschke *In its* Research and Development. Technical-Scientific Publications (1956-1987): Retrospective View and Prospects. Jubilee Edition on the Occasion of the 75th Anniversary of Dipl.-Engr. Dr.-Engr. E.H. Ludwig Boelkow 1987 p 135-140 In GERMAN (For primary document see N88-17819 10-31)
(MBB-Z-137/86) Copyright Avail: NTIS HC A14/MF A01

Methods for the investigation of the morphology of the Al2O3 layers, produced on aluminum sheets during metal-metal adhesive bonding, are discussed. Methods include removal of the Al2O3 in layers by ion etching hollowed by high-resolution raster electron microscopy, and the preparation of prints of the oxide layer in the primer or adhesive in order to determine the penetration or penetration depth in the oxide layer. It is found that the primer penetrates to the insulating anodic coating for a chromic-acid as well as for a phosphoric-acid anodic layer. ESA

N88-17841# Messerschmitt-Boelkow-Blohm G.m.b.H., Ottobrunn (West Germany). Abteilung Technologie-Entwicklung.
SILENCIUM RESONATORS (SILATORS) FOR THE ATTENUATION AND ELIMINATION OF SOUND [SILATOREN ZUR DAEMPFUNG UND DAEMMUNG VON SCHALL] c71
Oskar Bschorr and Eckehard Laudien *In its* Research and Development. Technical-Scientific Publications (1956-1987): Retrospective View and Prospects. Jubilee Edition on the Occasion of the 75th Anniversary of Dipl.-Engr. Dr.-Engr. E.H. Ludwig Boelkow 1987 p 141-146 In GERMAN (For primary document see N88-17819 10-31)
(MBB-Z-546/83) Copyright Avail: NTIS HC A14/MF A01

The mechanical sizing, acoustic characteristics, application domain, and basic testing of resonator elements (silators) are treated. The construction and operation of silators are outlined. It is explained how the sizing of a silator has to be chosen so that the resonator has a given resonance frequency at atmospheric pressure. The frequency-dependent flux impedance of a resonator is defined. A collection of staggered, tuned silators, with different spatial constellations, is presented for the case of broadband noise. Application spectrum in aeroacoustics and hydroacoustics is presented. The basic testing procedures for the determination of the acoustic characteristics of silators are outlined. ESA

N88-17842# Messerschmitt-Boelkow-Blohm G.m.b.H., Ottobrunn (West Germany). Unternehmensgruppe Hubschrauber und Flugzeuge.
PURPOSES AND TASKS OF HIGH-PERFORMANCE AIRCRAFT CONSTRUCTION [ZIELE UND AUFGABEN DES HOCHLEISTUNGSFLUGZEUGBAUS] c05
Oskar Friedrich *In its* Research and Development. Technical-Scientific Publications (1956-1987): Retrospective View and Prospects. Jubilee Edition on the Occasion of the 75th Anniversary of Dipl.-Engr. Dr.-Engr. E.H. Ludwig Boelkow 1987 p 147-150 In GERMAN (For primary document see N88-17819 10-31)
(MBB/LK-S/PUB/296) Copyright Avail: NTIS HC A14/MF A01

The purposes of the German aircraft industry in high-grade components are outlined. Program planning concerning life time increase and combat value enhancement is presented. The requirements for the European fighter aircraft (JF90 or EFA) are given. The challenges for Germany in the fields of manned spacecraft systems and spacecraft, and cooperation programs with third-party countries are discussed. ESA

N88-17843# Messerschmitt-Boelkow-Blohm G.m.b.H., Ottobrunn (West Germany). Helicopter and Military Aircraft Group.
FUTURE FIGHTER MANEUVERABILITY FOR AIR COMBAT c05
Wolfgang B. Herbst *In its* Research and Development. Technical-Scientific Publications (1956-1987): Retrospective View and Prospects. Jubilee Edition on the Occasion of the 75th Anniversary of Dipl.-Engr. Dr.-Engr. E.H. Ludwig Boelkow 1987 p 151-156 Presented at the AIAA Aircraft Design Systems and Operations Meeting, Fort Worth, Tex., 17-19 Oct. 1983 (For primary document see N88-17819 10-31)
(MBB/LKE-1/S/PUB/120) Copyright Avail: NTIS HC A14/MF A01

The changed air combat characteristics and fighter design criteria, resulting from weapons development, are treated. Manned and computerized air combat simulations, and fighter design analyses were performed. The results indicate that in short range combat the emphasis is shifting to attained turn rates and small radii of turn, and that high speed maneuverability is of particular importance in medium range combats. Significant improvement in short range combat effectiveness can be expected from tactical maneuvers including the penetration into the post-stall flight regime. A set of maneuverability design criteria is proposed. ESA

N88-17844# Messerschmitt-Boelkow-Blohm G.m.b.H., Ottobrunn (West Germany). Helicopter and Military Aircraft Group.
FLIGHT TESTING OF FIGHTER AIRCRAFT c05
Arnim Knaus *In its* Research and Development. Technical-Scientific Publications (1956-1987): Retrospective View and Prospects. Jubilee Edition on the Occasion of the 75th Anniversary of Dipl.-Engr. Dr.-Engr. E.H. Ludwig Boelkow 1987 p 157-166 (For primary document see N88-17819 10-31)
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The categories of flight test are overviewed. A typical full scale flight development plan, onboard data acquisition system, flight test data production and data flow, flight test control room, and performance data analysis software network are presented. The test procedure and sequential course of flight trials, and the

characteristics of fighter aircraft testing are discussed. The basic ground test prior to flight test, in-flight thrust/drag determination, flutter testing, flying qualities, integrated avionics testing, weapons trials, and operational aspects are explained. ESA

N88-17845# Messerschmitt-Boelkow-Blohm G.m.b.H., Ottobrunn (West Germany). Unternehmensgruppe Hubschrauber und Flugzeuge.

ACTIVE CONTROL TECHNOLOGY WITH ADAPTIVE CONTROL CONCEPT IN THE AIRCRAFT CONSTRUCTION [AKTIVE KONTROLL TECHNOLOGIE MIT ADAPTIVEM REGLERKONZEPT IM FLUGZEUGBAU] c08

Heinz Hoenlinger *In its* Research and Development. Technical-Scientific Publications (1956-1987): Retrospective View and Prospects. Jubilee Edition on the Occasion of the 75th Anniversary of Dipl.-Engr. Dr.-Engr. E.H. Ludwig Boelkow 1987 p 167-172 In GERMAN (For primary document see N88-17819 10-31)

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An adaptive control concept for active control techniques in structural dynamics was developed. The applicability of active control techniques in structural dynamics, the control principle for shimmy damping and loading reduction, and conventional electronics for active control technology are discussed. Wind tunnel tests of the adaptive control concept for active shimmy damping show that even the experimental, nonoptimized version has the same performances as the conventional systems. The use of an optimized target function for phase as well as for amplification can substantially improve performance and robustness. ESA

N88-17846# Messerschmitt-Boelkow-Blohm G.m.b.H., Ottobrunn (West Germany). Helicopter and Military Aircraft Group.

ZONAL SOLUTIONS FOR VISCOUS FLOW PROBLEMS. FINITE APPROXIMATIONS IN FLUID MECHANICS c34

Ernst H. Hirschel and Manfred A. Schmatz *In its* Research and Development. Technical-Scientific Publications (1956-1987): Retrospective View and Prospects. Jubilee Edition on the Occasion of the 75th Anniversary of Dipl.-Engr. Dr.-Engr. E.H. Ludwig Boelkow 1987 p 173-178 Repr. from Notes on Numerical Fluid Mechanics (Brunswick/Wiesbaden, Fed. Republic of Germany), v. 14, 1986 (For primary document see N88-17819 10-31)

(MBB/LKE-122/S/PUB/226) Copyright Avail: NTIS HC A14/MF A01

The concept of zonal solutions for viscous flow problems, where local solutions of the Navier-Stokes equations are coupled with solutions of the Euler equations and the boundary layer equations, is outlined. The basic idea is to solve the Navier-Stokes equations only in those parts of the flow field where strong interactions occur. The goal is to reduce computation costs, while improving the description of boundary layer and separation phenomena. The governing equations, computational grids, and coupling procedures for general steady three-dimensional viscous flows are presented. Examples for two-dimensional applications are given. ESA

N88-17847# Messerschmitt-Boelkow-Blohm G.m.b.H., Hamburg (West Germany). Unternehmensgruppe Transport- und Verkehrsflugzeuge.

AIRBUS, THE SUCCESSFUL EUROPEAN COOPERATION [AIRBUS - DIE ERFOLGREICHE EUROPAEISCHE KOOPERATION] c01

Hartmut Mehdorn *In its* Research and Development. Technical-Scientific Publications (1956-1987): Retrospective View and Prospects. Jubilee Edition on the Occasion of the 75th Anniversary of Dipl.-Engr. Dr.-Engr. E.H. Ludwig Boelkow 1987 p 179-182 In GERMAN (For primary document see N88-17819 10-31)

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The history of the European Airbus project is depicted. The structure, organization, responsibilities, and goals of Airbus Industry are explained. ESA

N88-17848# Messerschmitt-Boelkow-Blohm G.m.b.H., Bremen (West Germany). Unternehmensgruppe Transport- und Verkehrsflugzeuge.

THE INTELLIGENT WING. AERODYNAMIC DEVELOPMENT DIRECTION FOR FUTURE PASSENGER AIRCRAFT [DER INTELLIGENTE TRAGFLUEGEL - AERODYNAMISCHE ENTWICKLUNGSRICHTUNGEN FUER ZUKUENFTIGE VERKEHRSFLUGZEUGE] c05

Reinhard Hilbig and Joachim Szodruch *In its* Research and Development. Technical-Scientific Publications (1956-1987): Retrospective View and Prospects. Jubilee Edition on the Occasion of the 75th Anniversary of Dipl.-Engr. Dr.-Engr. E.H. Ludwig Boelkow 1987 p 183-186 In GERMAN (For primary document see N88-17819 10-31)

(MBB-UT-006/87) Copyright Avail: NTIS HC A14/MF A01

The status of aerodynamic technology is presented. The development potentials for passenger and transport aircraft are described. Aerodynamic solutions, leading to the realization of technologies which open the way to the forecast potential of large-aircraft construction, are illustrated by the wing with controlled flow and the transonic laminar wing. The examples demonstrate the necessity of medium and long range research programs and of longer term industrial strategies. ESA

N88-17849# Messerschmitt-Boelkow-Blohm G.m.b.H., Hamburg (West Germany). Unternehmensgruppe Transport- und Verkehrsflugzeuge.

PRODUCT PLANNING IN CIVIL AIRCRAFT CONSTRUCTION [PRODUKTPLANUNG IM ZIVILEN FLUGZEUGBAU] c01

Werner Zabka *In its* Research and Development. Technical-Scientific Publications (1956-1987): Retrospective View and Prospects. Jubilee Edition on the Occasion of the 75th Anniversary of Dipl.-Engr. Dr.-Engr. E.H. Ludwig Boelkow 1987 p 187-196 In GERMAN (For primary document see N88-17819 10-31)

(MBB-UT-002/87; VDI-619) Copyright Avail: NTIS HC A14/MF A01

Planning in the production of civil passenger aircraft is described. The general economic boundary conditions are given. The procurement of a new aircraft is discussed from the point of view of an airline company. The risks involved in the development of a new passenger aircraft are presented on the basis of the essential planning parameters and their mutual dependencies. The influence of the development domain on the efficiency of an aircraft program, and the use of value analysis are explained. ESA

N88-17850# Messerschmitt-Boelkow-Blohm G.m.b.H., Bremen (West Germany). Unternehmensgruppe Transport- und Verkehrsflugzeuge.

THE APPLICATION OF MODERN AEROELASTIC DEVELOPMENTS FOR FUTURE PROJECTS [DIE ANWENDUNG MODERNER AEROELASTISCHER ENTWICKLUNGEN FUER ZUKUENFTIGE PROJEKTE] c05

Helmut Zimmermann and Jens Hinrichsen *In its* Research and Development. Technical-Scientific Publications (1956-1987): Retrospective View and Prospects. Jubilee Edition on the Occasion of the 75th Anniversary of Dipl.-Engr. Dr.-Engr. E.H. Ludwig Boelkow 1987 p 197-202 In GERMAN (For primary document see N88-17819 10-31)

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The use of aeroelastic techniques and testing methods in aircraft construction is outlined. The history of aeroelasticity in aircraft construction is depicted. The aeroelastic treatment of the bending-torsion flutter of a wing is discussed. Aids for flutter optimization are explained. Aeroelastic problems in wing boxes made of carbon fiber reinforced plastics are presented. Flutter margin augmentation systems are outlined. Transonic aerodynamic forces in aerodynamics are treated. ESA

N88-17851# Messerschmitt-Boelkow-Blohm G.m.b.H., Hamburg (West Germany). Unternehmensgruppe Transport- und Verkehrsflugzeuge.
TRENDS IN THE DISTRIBUTION OF TASKS BETWEEN COMMERCIAL PILOTS AND FLIGHT CONTROL SYSTEMS [ZUR AUFGABENTEILUNG ZWISCHEN VERKEHRSPILOTEN UND FLUGFUEHRUNGSSYSTEMEN - TRENDS] c54
Hartwig Seeler *In its* Research and Development. Technical-Scientific Publications (1956-1987): Retrospective View and Prospects. Jubilee Edition on the Occasion of the 75th Anniversary of Dipl.-Engr. Dr.-Engr. E.H. Ludwig Boelkow 1987 p 203-208 In GERMAN (For primary document see N88-17819 10-31)
(MBB-UT-008/87) Copyright Avail: NTIS HC A14/MF A01
Trends to relieve pilots by a reorganization of the pilot and cockpit tasks are discussed. Simplification of the navigation tasks; radio telephony; interlocking of unacceptable pilot functions or flight paths; operational simplifications; and information are treated. ESA

N88-17852# Messerschmitt-Boelkow-Blohm G.m.b.H., Bremen (West Germany). Unternehmensgruppe Transport- und Verkehrsflugzeuge.
AN EXPERT SYSTEM TO SUPPORT THE VERIFICATION/VALIDATION OF FLIGHT-CRITICAL SOFTWARE [EIN EXPERTEN-SYSTEM ZUR UNTERSTUETZUNG DER VERIFIKATION/VALIDATION VON FLUGKRITISCHER SOFTWARE] c61
Norbert Heyder and Georgios Kastanakis *In its* Research and Development. Technical-Scientific Publications (1956-1987): Retrospective View and Prospects. Jubilee Edition on the Occasion of the 75th Anniversary of Dipl.-Engr. Dr.-Engr. E.H. Ludwig Boelkow 1987 p 209-212 In GERMAN (For primary document see N88-17819 10-31)
(MBB-UT-102/87) Copyright Avail: NTIS HC A14/MF A01
The applicability of an expert system in the verification/validation (VV) process of software that is flight-critical and close to hardware was investigated. The VV-process of flight-critical software is outlined. The essential role of an expert system in VV-activities is explained. A strategy aiming at a definition of the VV-task on the basis of the required quality characteristics, as well as at the development of a knowledge base consisting of structured information and rules is introduced. The significance of expert systems lies in domains where a broad, empirical knowledge, which cannot be covered by algorithms, plays an essential role. ESA

N88-17853# Messerschmitt-Boelkow-Blohm G.m.b.H., Ottobrunn (West Germany). Helicopter and Military Aircraft Group.
HELICOPTER ACTIVITIES IN GERMANY c05
Volker vonTein *In its* Research and Development. Technical-Scientific Publications (1956-1987): Retrospective View and Prospects. Jubilee Edition on the Occasion of the 75th Anniversary of Dipl.-Engr. Dr.-Engr. E.H. Ludwig Boelkow 1987 p 213-224 Presented at the 12th European Rotorcraft Forum, Garmisch-Partenkirchen, Fed. Republic of Germany, 22-25 Sep. 1986 Previously announced in IAA as A87-43401 (For primary document see N88-17819 10-31)
(MBB-UD-487/86) Copyright Avail: NTIS HC A14/MF A01
The history of German helicopter technology is depicted. The update of the BO 105 and BK117 programs is given. Statistical information about all types of helicopters operating in Germany and the related infrastructure is presented. The most important technology programs covering rotor technology, vibration suppression, advanced composite airframes, avionics/cockpits, and flight control are presented. The most important future helicopter projects with German participation, such as the PAH2, NH90, and ALH are described. ESA

N88-17854# Messerschmitt-Boelkow-Blohm G.m.b.H., Ottobrunn (West Germany). Unternehmensgruppe Hubschrauber und Flugzeuge.
TESTING OF A TAIL ROTOR SYSTEM IN A FIBER COMPOSITE TYPE OF CONSTRUCTION [ERPROBUNG EINES HECKROTORSYSTEMES IN FASERVERBUNDBAUWEISE] c05
Valenti Kloeppel and Bernhard Enenkel *In its* Research and Development. Technical-Scientific Publications (1956-1987): Retrospective View and Prospects. Jubilee Edition on the Occasion of the 75th Anniversary of Dipl.-Engr. Dr.-Engr. E.H. Ludwig Boelkow 1987 p 225-234 In GERMAN Presented at the BMFT-Status-Seminar, Munich, Fed. Republic of Germany, Apr. 1986 (For primary document see N88-17819 10-31)
(MBB-UD-472/86) Copyright Avail: NTIS HC A14/MF A01
An experimental version of a fiber composite, bearingless helicopter tail rotor was developed and tested, to improve aerodynamic efficiency, simplicity of construction, weight, and costs. A four-blade, bearingless, smooth rotation rotor was chosen. The design is based on a glass fiber torsion element that takes the impact and rotation bending as well as angular acceleration of the blades. The dynamic characteristics, mechanical and aeroelastic stability phenomena, as well as the loading and strain levels were determined. The test stand and test program are described. The test results were used to determine the dynamic loading due to a precession motion, and to simulate the ground resonance conditions required to verify aeromechanical stability. ESA

N88-17855# Messerschmitt-Boelkow-Blohm G.m.b.H., Ottobrunn (West Germany). Unternehmensgruppe Wehrtechnik.
ROTOR SAR (ROSAR): A NEW HIGH-RESOLUTION ALL-WEATHER VISION METHOD FOR HELICOPTERS [ROSAR - EIN NEUES HOCHAUFLOESENDES ALLWETTERSICHTVERFAHREN FUER HUBSCHRAUBER] c32
Horst Kaltschmidt and Helmut Klausing (Deutsche Forschungs- und Versuchsanstalt fuer Luft- und Raumfahrt, Oberpfaffenhofen, West Germany) *In its* Research and Development. Technical-Scientific Publications (1956-1987): Retrospective View and Prospects. Jubilee Edition on the Occasion of the 75th Anniversary of Dipl.-Engr. Dr.-Engr. E.H. Ludwig Boelkow 1987 p 235-240 In GERMAN (For primary document see N88-17819 10-31)
(MBB-UA-1046/87) Copyright Avail: NTIS HC A14/MF A01
The concept of an all-weather, high-resolution SAR system, based on rotating antennas integrated in helicopter blade tips (ROSAR) is presented. The opposition between resolution and transparency at several wavelengths, and antenna aperture increase as a solution are discussed. The principle of synthetic aperture radar, and determination of the resolution by theoretical signal recognition methods are explained. The fundamentals of the ROSAR concept are presented. As a systems design example, the SAR parameters for the frequencies 35 and 94 GHz are given. ESA

N88-17856# Messerschmitt-Boelkow-Blohm G.m.b.H., Ottobrunn (West Germany). Unternehmensgruppe Raumfahrt.
THE PROSPECTS OF SPACE UTILIZATION [PERSPEKTIVEN DER WALTRAUMNUTZUNG] c29
Othmar Heise *In its* Research and Development. Technical-Scientific Publications (1956-1987): Retrospective View and Prospects. Jubilee Edition on the Occasion of the 75th Anniversary of Dipl.-Engr. Dr.-Engr. E.H. Ludwig Boelkow 1987 p 241-250 In GERMAN (For primary document see N88-17819 10-31)
(MBB-UR-931/86; BDI-187) Copyright Avail: NTIS HC A14/MF A01
The status of the industrial utilization of space is depicted. Examples of applications in astronomy and astrophysics are given. The possibilities related to Earth observation from space and meteorology offered by space techniques are listed. The most commercialized application of space techniques namely

telecommunications, is outlined. In use of weightlessness, the status of microgravity applications, the physical effects of microgravity, and the market for microgravity are presented.
ESA

N88-17857# Messerschmitt-Boelkow-Blohm G.m.b.H., Ottobrunn (West Germany). Unternehmensgruppe Raumfahrt.
TRENDS IN THE DEVELOPMENT OF SPACE TRANSPORTATION SYSTEMS [ENTWICKLUNGSTENDENZEN BEI RUAMTRANSPORTERN] **c16**
Ernst Hoegenauer *In its* Research and Development. Technical-Scientific Publications (1956-1987): Retrospective View and Prospects. Jubilee Edition on the Occasion of the 75th Anniversary of Dipl.-Engr. Dr.-Engr. E.H. Ludwig Boelkow 1987 p 251-256 In GERMAN (For primary document see N88-17819 10-31)
(MBB-UR-911/86) Copyright Avail: NTIS HC A14/MF A01
Technical aspects of the development of space transportation system, and their implications are treated. The scenario for space transportation in the year 2000 is depicted, and global European transport costs are forecast. Cost reduction to be expected from reusable spacecraft such as Hermes is outlined. The criteria for the design of a European transportation system are given. The concepts for the future US and UK generation of space transportation systems are presented. ESA

N88-17858# Messerschmitt-Boelkow-Blohm G.m.b.H., Bremen (West Germany). Unternehmensgruppe Raumfahrt.
PROJECT MANAGEMENT IN ASTRONAUTICS: FROM SPACELAB TO COLUMBUS [PROJEKT-MANAGEMENT IN DER RAUMFAHRT- VON SPACELAB ZU COLUMBUS] **c81**
Ants Kutzer *In its* Research and Development. Technical-Scientific Publications (1956-1987): Retrospective View and Prospects. Jubilee Edition on the Occasion of the 75th Anniversary of Dipl.-Engr. Dr.-Engr. E.H. Ludwig Boelkow 1987 p 257-262 In GERMAN Presented at a conference, Aachen, Fed. Republic of Germany, 29 Jan. 1987 (For primary document see N88-17819 10-31)
(MBB-URE-943/87) Copyright Avail: NTIS HC A14/MF A01
The history of the Spacelab project is depicted. The modular construction, the major Spacelab flight elements, flight hardware, flight configurations, and typical missions are described. Frequently occurring errors, which have to be considered by the management, are discussed. The concept of the European Columbus project is outlined. The industrial and management organization of the project are presented. ESA

N88-17859# Messerschmitt-Boelkow-Blohm G.m.b.H., Ottobrunn (West Germany). Space Systems Group.
THREE-DIMENSIONAL EULER SOLUTIONS FOR HYPERSONIC MACH NUMBERS **c02**
Michael Pfitzner and Claus Weiland *In its* Research and Development. Technical-Scientific Publications (1956-1987): Retrospective View and Prospects. Jubilee Edition on the Occasion of the 75th Anniversary of Dipl.-Engr. Dr.-Engr. E.H. Ludwig Boeklow 1987 p 263-272 Presented at the AGARD Conference on Aerodynamics of Hypersonic Lifting Vehicles, Bristol, United Kingdom, 6-7 Sep. 1987 (For primary document see N88-17819 10-31)
(MBB-UR-944/87) Copyright Avail: NTIS HC A14/MF A01
The integration of the three-dimensional unsteady and steady Euler equations in the regime of hypersonic flow (Mach number between 4 and 30) is discussed, with a view to the control of aerothermal problems of reusable reentry vehicles and hypersonic missiles. The formulation of the Euler equations in quasi-conservative form and the use of a third order upwind biased discretization formula guarantees an accurate and robust algorithm with good shock capturing cababilities. It is shown that with a procedure that fits the strong bow shock and captures the enbedded shocks, more accurate flow fields with less grid points can be achieved. The generalization of the basic equations and of the upwind algorithm to deal with a general equation of state is discussed. For air, the equilibrium equation of state can be calculated through existing Mollier-fit routines. ESA

N88-17860# Messerschmitt-Boelkow-Blohm G.m.b.H., Ottobrunn (West Germany). Unternehmensgruppe Wehrtechnik.
THE MILITARY TECHNIQUES OF TOMORROW. A CONTRIBUTION TO ACTIVE PEACE ASSURANCE [DIE WEHRTECHNIK VON MORGEN - EIN BEITRAG ZUR AKTIVEN FRIEDENSSICHERUNG] **c66**
Roland Mecklinger *In its* Research and Development. Technical-Scientific Publications (1956-1987): Retrospective View and Prospects. Jubilee Edition on the Occasion of the 75th Anniversary of Dipl.-Engr. Dr.-Engr. E.H. Ludwig Boelkow 1987 p 274-278 In GERMAN (For primary document see N88-17819 10-31)
(MBB-UA-1049/87) Copyright Avail: NTIS HC A14/MF A01
The defense capabilities of conventional weapon systems are discussed with a view to a reduction of nuclear arms. The interaction between the applied tactics and weapons techniques is treated. The present technological possibilities to increase fighting capacity are outlined. ESA

N88-17861# Messerschmitt-Boelkow-Blohm G.m.b.H., Schrobenhausen (West Germany). Defense Systems Group.
PENETRATION THEORY FOR INCLINED AND MOVING SHAPED CHARGES **c37**
Manfred Held and Rainer Fischer *In its* Research and Development. Technical-Scientific Publications (1956-1987): Retrospective View and Prospects. Jubilee Edition on the Occasion of the 75th Anniversary of Dipl.-Engr. Dr.-Engr. E.H. Ludwig Boelkow 1987 p 279-284 (For primary document see N88-17819 10-31)
(MBB-UA-940/86) Copyright Avail: NTIS HC A14/MF A01
An analytical model for the calculation of the dynamic penetration of inclined shaped charges is presented. Shaped charges at an arbitrary standoff distance, and all possible angles between the shaped charge axis and the axis of the carrier, as well as various obliqueness of the target plate were considered. The advantage of an analytical model is that estimates of penetration and trends can be established quickly and easily through a variation of shaped-charge-and target parameters.
ESA

N88-17862# Messerschmitt-Boelkow-Blohm G.m.b.H., Ottobrunn (West Germany). Unternhemensgruppe Wehrtechnik.
POLYPHEM, A UNIVERSAL DEFENSIVE MISSILE WITH OPTICAL WAVEGUIDES GUIDANCE [POLYPHEM - EIN UNIVERSELLER ABWEHR-FLUGKOERPER MIT LICHTWELLENLIETERLENKUNG] **c15**
Karl Heinz Niederhofer, Wolfgang vonHoessle, and Wolf-Dieter Schuck *In its* Research and Development. Technical-Scientific Publications (1956-1987): Retrospective View and Prospects. Jubilee Edition on the Occasion of the 75th Anniversary of Dipl.-Engr. Dr.-Engr. E.H. Ludwig Boelkow (date) 285-288 (SEE N88-17819 10-31) 1987 In GERMAN (For primary document see N88-17819 10-31)
(MBB-UA-1045/87) Copyright Avail: NTIS HC A14/MF A01
A system using optical waveguide as transmission medium between missile and control position was designed. The advantages of such a system with respect to wire-controlled missiles are given. The structure of the transmission system is outlined. The technology used for signal registration, transmission, and processing is presented. The operational use and the realization of the system are explained. ESA

N88-17863# Messerschmitt-Boelkow-Blohm G.m.b.H., Ottobrunn (West Germany). Unternehmensgruppe Wehrtechnik.
AERODYNAMIC ASPECTS OF THE CONFIGURATIONAL SYSTEMS LAYOUT OF A DISPENSER [AERODYNAMISCHE GESICHTSPUNKTE DER KONFIGURATIVEN SYSTEMAUSLEGUNG EINES DISPENSERS] **c05**
Horst Schneider *In its* Research and Development. Technical-Scientific Publications (1956-1987): Retrospective View

and Prospects. Jubilee Edition on the Occasion of the 75th Anniversary of Dipl.-Engr. Dr.-Engr. E.H. Ludwig Boelkow 1987 p 289-292 In GERMAN (For primary document see N88-17819 10-31)
(MBB-UA-1047/87) Copyright Avail: NTIS HC A14/MF A01

Details of the configurational development of a dispenser system are treated. The design was based on experience in dispenser development and on preliminary investigations, taking into account geometrical compatibility requirements. The different investigated fin forms are presented. The aerodynamic stability behavior of the investigated fuselage-wing-fin configurations is discussed. ESA

N88-17864# Messerschmitt-Boelkow-Blohm G.m.b.H., Ottobrunn (West Germany). Unternehmensgruppe Wehrtechnik.
EXPERIMENTS FOR THE HIGH RESOLUTION DETECTION OF MOVING TARGETS USING A CO2 LASER RADAR [EXPERIMENTE ZUR HOCHAUFGELOESTEN ERFASSUNG VON VEWEGTZIELEN MIT EINEM CO2-LASER-RADAR] c32
Armin Breinig *In its* Research and Development. Technical-Scientific Publications (1956-1987): Retrospective View and Prospects. Jubilee Edition on the Occasion of the 75th Anniversary of Dipl.-Engr. Dr.-Engr. E.H. Ludwig Boelkow 1987 p 293-296 In GERMAN (For primary document see N88-17819 10-31)
(MBB-UA-1044/87) Copyright Avail: NTIS HC A14/MF A01

The fundamentals of IR radar systems are outlined. Moving target detection using optical superheterodyne reception is explained. The optical design of a CO2 laser radar, optimized for motion detection, is presented. Ranges of a few kilometers are obtained, even under unfavorable conditions. ESA

N88-17865# Messerschmitt-Boelkow-Blohm G.m.b.H., Ottobrunn (West Germany). Zentralbereich Industrieerzeugnisse.
THE MBB PROPULSION CONCEPTS FOR MAGNETIC SUSPENSION RAILWAYS: RETROSPECTIVE VIEW AND PROSPECTS [MBB-ANTRIEBSKONZEPTE FUER MAGNETSCHWEBEBAHNEN - RUECKSCHAU UND AUSBLICK]
Dieter Reismayr *In its* Research and Development. Technical-Scientific Publications (1956-1987): Retrospective View and Prospects. Jubilee Edition on the Occasion of the 75th Anniversary of Dipl.-Engr. Dr.-Engr. E.H. Ludwig Boelkow 1987 p 297-300 In GERMAN (For primary document see N88-17819 10-31)
(MBB-Z-141/87) Copyright Avail: NTIS HC A14/MF A01

The principles of contactless linear propulsion are given. The advantages of asynchronous short-stator motors, as well as developments and testing procedures are presented. The disadvantage of the short-stator motor is that it requires a high power current transmission. Development of long-stator magnets for the vehicles TR05 and TR06 are described. The economic aspects of the short and long-stator principles are discussed. ESA

N88-17866# Messerschmitt-Boelkow-Blohm G.m.b.H., Ottobrunn (West Germany).
MESSERSCHMITT-BOELKOW-BLOHM: A COMPANY WITH A TRADITION [MESSERSCHMITT-BOELKOW-BLOHM- EIN UNTERNEHMEN MIT TRADITION]
In its Research and Development. Technical-Scientific Publications (1956-1987): Retrospective View and Prospects. Jubilee Edition on the Occasion of the 75th Anniversary of Dipl.-Engr. Dr.-Engr. E.H. Ludwig Boelkow 1987 p 303-306 In GERMAN (For primary document see N88-17819 10-31)
Copyright Avail: NTIS HC A14/MF A01

The German aeronautics tradition within MBB is outlined. The historical development and the future of MBB activities in the field of military techniques are given. Activities in unmanned and manned space systems are presented. ESA

N88-17867# Messerschmitt-Boelkow-Blohm G.m.b.H., Ottobrunn (West Germany).
MESSERSCHMITT-BOELKOW-BLOHM: BIOGRAPHY AND HISTORY OF A COMPANY [MESSERSCHMITT-BOELKOW-BLOHM- EIN UNTERNEHMENSBIOGRAPHIE; FIRMENGESCHICHTE]
In its Research and Development. Technical-Scientific Publications (1956-1987): Retrospective View and Prospects. Jubilee Edition on the Occasion of the 75th Anniversary of Dipl.-Engr. Dr.-Engr. E.H. Ludwig Boelkow 1987 p 307-314 In GERMAN (For primary document see N88-17819 10-31)
Copyright Avail: NTIS HC A14/MF A01

The history of MBB from 1956 till 1987 is depicted. ESA

N88-17868# Messerschmitt-Boelkow-Blohm G.m.b.H., Ottobrunn (West Germany).
MESSERSCHMITT-BOELKOW-BLOHM, THE COMPANY TODAY. DATA, NUMBERS AND FACTS [MESSERSCHMITT-BOELKOW-BLOHM- DAS UNTERNEHMEN HEUTE. DATEN, ZAHLEN UND FAKTEN]
In its Research and Development. Technical-Scientific Publications (1956-1987): Retrospective View and Prospects. Jubilee Edition on the Occasion of the 75th Anniversary of Dipl.-Engr. Dr.-Engr. E.H. Ludwig Boelkow 1987 p 315-317 In GERMAN (For primary document see N88-17819 10-31)
Copyright Avail: NTIS HC A14/MF A01

The present structure of MBB is depicted. The management and turnover structures are presented. Participation in international cooperation programs is given. The activities of the different groups constituting MBB are listed. ESA

N88-17869*# National Aeronautics and Space Administration. Marshall Space Flight Center, Huntsville, Ala.
A GENERALIZED METHOD FOR AUTOMATIC DOWNHAND AND WIREFEED CONTROL OF A WELDING ROBOT AND POSITIONER
Ken Fernandez and George E. Cook (Vanderbilt Univ., Nashville, Tenn.) Feb. 1988 54 p
(NASA-TP-2807; NAS 1.60:2807) Avail: NTIS HC A04/MF A01 CSCL 13H

A generalized method for controlling a six degree-of-freedom (DOF) robot and a two DOF positioner used for arc welding operations is described. The welding path is defined in the part reference frame, and robot/positioner joint angles of the equivalent eight DOF serial linkage are determined via an iterative solution. Three algorithms are presented: the first solution controls motion of the eight DOF mechanism such that proper torch motion is achieved while minimizing the sum-of-squares of joint displacements; the second algorithm adds two constraint equations to achieve torch control while maintaining part orientation so that welding occurs in the downhand position; and the third algorithm adds the ability to control the proper orientation of a wire feed mechanism used in gas tungsten arc (GTA) welding operations. A verification of these algorithms is given using ROBOSIM, a NASA developed computer graphic simulation software package design for robot systems development. Author

N88-17870# Joint Publications Research Service, Arlington, Va.
JPRS REPORT: SCIENCE AND TECHNOLOGY. EUROPE AND LATIN AMERICA
22 Jan. 1988 122 p
(JPRS-ELS-88-002) Avail: NTIS HC A06/MF A01

Articles from the popular and trade press are included on the following subjects: advanced materials, aerospace industry, automotive industry, biotechnology, computers, factory automation and robotics, microelectronics, and science and technology policy. The aerospace articles discuss briefly and in a nontechnical way the SAGEM bubble memories for space applications, Ariane V new testing facilities, innovative technologies of TDF-1 satellite, and the restructuring of the Aviation Division at France's Aerospatiale. J.P.B.

N88-17871# New Mexico Univ., Albuquerque. Engineering Research Inst.
EVALUATION OF BITUMINOUS MATERIALS USED IN PAVEMENT RECYCLING PROJECTS AT TYNDALL, MACDILL, AND HURLBURT AIR FORCE BASES Final Report, Feb. 1985 - Dec. 1986
B. Kiggundu, R. Martinez, B. Humphrey, and T. Shuler Jul. 1987 212 p
(Contract F2901-84-C-0080)
(AD-A188068; NMERI-WA5-11(5.07); AFESC/ESL-TR-86-50)
Avail: NTIS HC A10/MF A01 CSCL 13C

This report presents results of a study involving bituminous materials from Tyndall and MacDill Air Force Bases and Hurlburt Field. These materials included Reclaimed Asphalt Pavement (RAP), modifiers, virgin asphalts, and new aggregates. A tentative modifier selection criterion was used to judge the quality of materials used in the recycling efforts at the respective sites. The results showed that independent adequacy of physical properties from chemical properties in selection of modifiers could not be established. However, some of the results showed that physical properties were more sensitive indicators of changes in binders due to aging. In addition, this report includes the tentative modifier selection criteria and results of an interlaboratory study from which variability limits to parameters determined using modified Clay-Gel and Heithaus procedures are established. The modified Clay-Gel and Heithaus procedures are included. GRA

32 COMMUNICATIONS AND RADAR

Includes radar; land and global communications; communications theory; and optical communications.

For related information see also *04 Aircraft Communications and Navigation* and *17 Space Communications, Spacecraft Communications, Command and Tracking.* For search and rescue see *03 Air Transportation and Safety,* and *16 Space Transportation.*

N88-17872# Ocean Research and Engineering, La Canada, Calif.
SAR (SYNTHETIC APERTURE RADAR) IMAGING OF SHIP WAKES IN THE GULF OF ALASKA Final Report, 1984 - 1987
Omar H. Shemdin Jul. 1987 189 p Prepared in cooperation with JPL, Pasadena, Calif.
(Contract N00014-85-C-0221)
(AD-A186554) Avail: NTIS HC A09/MF A01 CSCL 20N

Conclusions include: (1) The half-angles associated with narrow-V wakes are consistent with first-order Bragg surface theory. (2) The decay rate along the bright arms of the narrow-V wake is consistent with a combined viscous and radiation decay of short surface wave with first-order Bragg wave lengths. (3) Narrow-V wakes are observed in Sea States 1 to 3 at incidence angles less than or equal to 44 deg. The limitation is due to the noise threshold of the SAR system used. (4) The longest narrow-V wakes bright-arm observed is 12.0 km (31 deg incidence angle) in Sea State 1, 3.9 km (44 deg incidence angle) in Sea State 2 and 4.3 km (24 deg incidence angle) in Sea State 3. In Sea State 4 no narrow-V wakes could be observed. (5) The turbulent wake (dark band between bright arms) is observed in Sea States 1 to 3 at incidence angles less than 53 deg. The limitations is due to the noise threshold in the SAR system used. (6) The longest turbulent wake length observed is 41 km (37 deg incidence angle) in Sea State 1, 4.5 km (35 deg incidence angle) in Sea State 2 and 5.5 km (24 deg incidence angle) in Sea State 3. No turbulent wake is observed in Sea State 4. Sea State 3. No turbulent wake is observed in Sea State 4. GRA

N88-17873# National Weather Service, Salt Lake City, Utah.
INEXPENSIVE SOLUTION FOR THE MASS DISTRIBUTION OF SATELLITE IMAGES
G. W. Sampson and G. Clark Sep. 1987 124 p
(PB88-114038; NOAA-TM-NWS-WR-201) Avail: NTIS HC A06/MF A01 CSCL 04B

A method for the mass distribution of satellite images is described. The method involves the establishment of a central distribution point which can service numerous remote users via dial telephone connections. The system design is centered around the IBM Personal Computer with costs maintained as low as possible. The central distribution point receives data from a GOESTAP line, or a WEFAX signal, compresses the data into viable satellite images and services remote user requests. The remote users dial into the central distribution point and retrieve the data. Once data are retrieved, the remote locations have the ability to display single images, animate a series of images, and manipulate the enhancement curve used to display the images. Complete instructions for system duplication are included.

Author

N88-17874# National Telecommunications and Information Administration, Boulder, Colo. Inst. for Telecommunication Sciences.
WIDEBAND HF (HIGH FREQUENCY) MODELING AND SIMULATION
J. A. Hoffmeyer and M. Nesenbergs Jul. 1987 95 p Sponsored by Joint Test Directorate (IOT/E), Fort Huachuca, Ariz.
(PB88-116116; NTIA-87-221) Avail: NTIS HC A05/MF A01 CSCL 17B

An elementary review of ionospheric propagation is presented, which summarizes the recent work in spread spectrum technology targeted for the HF radio band. Thereafter follows a short section devoted to additive distortions, namely noise and interference, also in the HF band. Past narrowband HF models are assessed: their background, old validation tests, and, to be quite specific, the NTIA/ITS development of the Watterson simulator. That laboratory tool, judged best by many, works in real time and offers accurate representations of HF channel bandwidths up to 10 to 12 kHz. In the present study, an extension to wideband models is attempted. Unfortunately, it suffers from an apparently serious shortage of measured data for the time-varying channel transfer function. A possible wideband model is hypothesized, conjectures are made, and questions are raised. One is left faced with a requirement for an experimental program to ascertain the wideband (1 MHz or more) characteristics of multipath fading for digital radio transmissions in the 2 to 30 MHz band and over radio propagation paths of interest. GRA

N88-17875# National Telecommunications and Information Administration, Boulder, Colo. Inst. for Telecommunication Sciences.
USER'S GUIDE FOR THE HF (HIGH FREQUENCY) BROADCAST ANTENNA DESIGN AND VALIDATION SUMMARY PROGRAMS
E. J. Haakinson, S. L. Rothschild, and J. R. Godwin Jul. 1987 110 p Sponsored by Voice of America, Washington, D.C.
(PB88-116124; NTIA-87-220) Avail: NTIS HC A06/MF A01 CSCL 20N

A series of programs were developed by the Institute for Telecommunication Sciences (ITS) that assist the Voice of America (VOA) to plan and operate high frequency (HF) broadcast stations. The VOA has specific bands available for use and has particular reception areas to cover. Because of the long distance between the broadcast transmitter and the reception areas, the primary mode of communication is via HF sky wave. Since the ionosphere, which supports HF sky wave, varies with the time of the day, season of the year, frequency, and sunspot number, the HF broadcast antenna design and validation summary programs must calculate the best frequency and the required antsnna power gain and pattern for the various conditions that apply to a particular broadcast scenario. The document will guide the user through the use of the programs, provide samples of the input to each program, and give examples of each program's output. GRA

N88-17876 British Broadcasting Corp., Kingswood (England). Engineering Div.
DESIGNING VARIABLE-LENGTH CODES WITH GOOD ERROR-RECOVERY PROPERTIES

M. J. Knee Nov. 1987 15 p
(BBC-RD-1987/19; EL-190) Avail: Issuing Activity

An algorithm for calculating the expected resynchronization time of a variable-length code following a transmission error is described. The results of calculations based on examples are used, together with insights gained from a simplification of the algorithm, to determine the effect on the expected resynchronization time of certain easily recognized design features of codes. The Report concludes that, if a code is designed carefully according to a few simple principles, its error-recovery properties may be significantly better than those resulting from a straightforward application of, for example, the Huffman algorithm. Such improvements are particularly important in the design of codes for digital television bit-rate reduction systems. Author

N88-17877 British Broadcasting Corp., Kingswood (England). Engineering Div.
THE RELATIONSHIP BETWEEN VISION CARRIER-TO-NOISE RATIO AND PICTURE SIGNAL-TO-NOISE RATIO IN A SYSTEM I TELEVISION RECEIVER
A. P. Robinson Dec. 1987 20 p
(BBC-RD-1987/23; RA-236) Avail: Issuing Activity

Definitions of vision carrier-to-noise ratio and picture signal-to-noise ratio are given, including a definition of noise bandwidth appropriate to a vestigial-sideband receiver. For television System I, it is shown both by theory and experiment that the picture signal-to-noise ratio is 8 dB less than the vision carrier-to-noise ratio. The effect on this result of filtering in the system is discussed and the noise characteristics of a domestic television receiver are presented. A justification is given for the minimum field strengths recommended by the CCIR for a television service. Author

N88-17878 British Broadcasting Corp., Kingswood (England). Engineering Div.
THE ASSESSMENT OF THE SOUND INSULATION REQUIREMENTS FOR A LARGE BROADCASTING STUDIO, USING A SCALE MODEL: PRACTICAL DETAILS
E. W. Taylor Dec. 1987 18 p
(BBC-RD-1987/21; PH-287) Avail: Issuing Activity

The techniques used in carrying out the assessment of relative levels of road traffic noise at the surfaces of a large building, using a scale model, are described. The results of such an assessment on a 100:1 scale model of a proposed new building at the BBC's Television Center are considered. The choice of a type of wall design which minimizes the construction costs of the building, while maintaining adequate insulation from road traffic noise, is outlined. Author

N88-17879# California Univ., Los Angeles.
UNIVERSAL POWER SPECTRA FOR WAVE TURBULENCE: APPLICATIONS TO WIND WAVES, FLICKER NOISE, SOLAR WIND SPECTRUM AND CLASSICAL SECOND SOUND Ph.D. Thesis
Andres Larraza [1987] 73 p
Avail: Univ. Microfilms Order No. DA8723177

Stationary solutions to the kinetic equation describing wave-wave interactions are obtained by means of dimensional estimates and in exact form from the collision operator. The solutions are interpreted as the turbulent spectrum in the inertial range and are shown to be local. At lowest nonlinear order one obtains the results of weak turbulence theory. As the low freqency power input is increased, the power spectrum of wave motion converges to a universal 1/f noise for nondispersive waves in more than two dimensions, and to 1/gamma sup 5 noise for deep gravity waves. It is also shown that a wave turbulent system is elastic and it can support a propagating energy mode with similarities to second sound. The conditions from parabolic to hyperbolic energy transport are discussed. A parallel connection to He-4 for drift wave turbulence in plasma is made and order of magnitide estimates for the plasma diffusivity obtained. It is also suggested that a wave turbulence picture can be used to understand the magnetic field fluctuations in the solar wind. Dissert. Abstr.

N88-17880*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.
MODELING OF SOME COPLANAR WAVEGUIDE DISCONTINUITIES
Rainee N. Simons and George E. Ponchak 1988 10 p Proposed for presentation at the IEEE MTT-S International Microwave Symposium, New York, N.Y., 25-27 May 1988
(NASA-TM-100808; E-3981; NAS 1.15:100808) Avail: NTIS HC A02/MF A01 CSCL 20N

Presented are lumped equivalent circuit models for several coplanar waveguide discontinuities such as an open circuit, a series gap, and a symmetric step, and their element values as a function of the discontinuity physical dimensions. The model element values are de-embedded from measured S-parameters. The frequency dependence of the effective dielectric constant was measured and compared to computed values. Author

N88-17881# Helsinki Univ. of Technology, Espoo (Finland). Communications Lab.
HELSINKI UNIVERSITY OF TECHNOLOGY COMMUNICATIONS LABORATORY Annual Report, 1986
S. J. Halme 1987 58 p
(PB88-112974; ISBN-951-754-218-6) Avail: NTIS HC A04/MF A01 CSCL 17B

The activities of the Communications Laboratory during 1986 are described. The Communications Laboratory is part of the Department of Electronics within the Faculty of Electrical Engineering at the Helsinki University of Technology. During 1986, the Communications Laboratory was active in the fields of optical fiber communications, fixed and mobile radio communications, telecommunications networks, signal processing, and communication services. In addition to communication theory, the laboratory has capabilities in various technologies including analog, pulse and digital electronic circuits, optical and radio systems, and software as applied to the specific problems of communication systems and networks. GRA

N88-17882# Technische Hogeschool, Delft (Netherlands). Afd. der Elektrotechnieik.
RADAR REFLECTIVITY AND ATTENUATION OF RADIO WAVES IN THE MELTING LAYER OF PRECIPITATION
W. Klaassen May 1987 41 p Sponsored by Stichting voor de Technische Wetenschappen, Utrecht, Netherlands
(PB88-121553) Avail: NTIS HC A03/MF A01 CSCL 20N

The melting layer in precipitation is physically modeled and compared with high resolution Doppler radar data. The model includes a new formulation of the dielectric properties and can handle all ice particles with densities ranging between pure snow and hail. The air temperature is calculated from the vertical air velocity. The model can handle aggregation, breakup, and collapse of the melting particles. The results of the model are in good agreement with the Doppler radar observations. The model shows that the reflectivity and attenuation are very sensitive to the dielectric properties and density of the melting particles, and that the influence of aggregation and the collapse is restricted. Simple relations between the attenuation and the rain intensity and maximum reflectivity are derived from a statistical analysis. GRA

N88-17883# Oak Ridge National Lab., Tenn.
CAPACITOR ANALYSIS FOR RF ANTENNAS
W. H. Power, F. W. Baity, and D. J. Hoffman 1987 4 p Presented at the 12th Symposium on Fusion Engineering, Monterey, Calif., 12 Oct. 1987
(Contract DE-AC05-84OR-21400)
(DE88-004178; CONF-871007-82) Avail: NTIS HC A02

Commercially available vacuum capacitors have been used in radio frequency (RF) antenna designs. The dimensional envelope of the capacitors has adapted favorably to antenna concepts. However, capacitors that are commercially available have not demonstrated acceptable performance characteristics for maximum

design currents of 800 A rms at 80 MHz and 1300 A rms at 30 MHz or for voltages of 50 kV peak. The reason for capacitor failure was investigated. The investigation consisted of establishing existing mechanical design features, defining desired operating criteria of key capacitor components, determining component design limitations, and developing a modified concept for testing. The design criteria included a variable capacitance range of 50 to 450 pF at the maximum current conditions. Effects of capacitor cooling by means of radiative transfer and forced convective transfer were considered. The resulting modified capacitor design concept uses as many components of the commercially available capacitors as possible. An apparatus for testing and evaluation was designed for the proposed capacitor concepts. Tests have demonstrated reliable operations at 750 A and 80 MHz CW on a similar design. DOE

N88-17884# Foersvarets Forskingsanstalt, Stockholm (Sweden).
MTI-INTERFACE (MOVING TARGET INDICATION-INTERFACE) FOR SIMPLE RADAR
E. Arvidsson Sep. 1987 30 p In SWEDISH; ENGLISH summary
(PB88-126578; FOA-C-30463-3.2) Avail: NTIS HC A03/MF A01 CSCL 17I

The report gives a short description of a digital MTI-interface designed for simple and cheap marine radar. The MTI-interface circuit uses digital Doppler filters and advanced fast digital components. The results show that it is possible for land-based radar to separate moving target echoes from ground echoes to a sufficiently effective degree for several important applications. GRA

N88-17885# National Bureau of Standards, Boulder, Colo. Center for Electronics and Electrical Engineering.
MEASUREMENT OF SHIELDING EFFECTIVENESS OF DIFFERENT CABLE AND SHIELDING CONFIGURATIONS BY MODE-STIRRED TECHNIQUES
Ramon L. Jesch Oct. 1987 24 p Sponsored by Army Aviation Systems Command, St. Louis, Mo.
(PB88-155791; NBSIR-87/3076) Avail: NTIS HC A03/MF A01 CSCL 20N

The shielding effectiveness of cable configurations having different shielding arrangements and of shielding configurations used to terminate cable shields for helicopter wiring were measured by mode-stirred techniques. The mode-stirred measurements were taken at discrete frequencies between 200 MHz and 6 GHz. In addition, shield effectiveness data on the shielding configurations were also obtained in a TEM cell down to 1 MHz. A description of the cable and shielding configurations is given, along with plots of the measured shielding effectiveness data as a function of frequency. Author

N88-17886# Technische Hogeschool, Delft (Netherlands). Afd. der Elektrotechniek.
TIME-DOMAIN RECIPROCITY THEOREMS FOR ELECTROMAGNETIC FIELDS IN DISPERSIVE MEDIA
A. T. deHoop May 1987 35 p
(PB88-126925; Rept-1987-15) Avail: NTIS HC A03/MF A01 CSCL 20N

Time domain reciprocity theorems of the time convolution and the time correlation type for electromagnetic fields in linear, time invariant, and locally reacting media are discussed. Inhomogeneous, anisotropic, and arbitrarily dispersive, both active and passive, media are included. The analysis is entirely carried out in space time, without intermediate recourse to the frequency or the wavevector domain. The application to inverse source and inverse constituency (or inverse profiling) problems is briefly indicated. Author

N88-17887# Technische Hogeschool, Delft (Netherlands). Afd. der Elektrotechniek.
DIRECT SCATTERING OF ELECTROMAGNETIC WAVES BY ONE- AND TWO-DIMENSIONAL OBJECTS AND ITS USE FOR INVERSE PROFILING
A. G. Tijhuis Jun. 1987 39 p
(PB88-126909; Rept-1987-19) Avail: NTIS HC A03/MF A01 CSCL 20N

Electromagnetic scattering problems as indicated in transient plane wave scattering by an inhomogeneous, lossy dielectric obstacle embedded in vacuum is investigated. As far as the direct scattering problem is concerned, transient plane wave scattering by one- and two-dimensional, inhomogeneous, penetrable obstacles are concentrated on. In the inverse case, the discussion is limited to the class of one dimensional problems. Thanks to these restrictions, the analytical as well as the computational aspects of a number of solution techniques were investigated in full detail. In formulating these solution techniques, on the other hand, the authors have attempted to preserve their capability of being generalized to more complicated geometries. Author

N88-17888# California Univ., Berkeley. Lawrence Berkeley Lab.
SIGNAL PROCESSING FOR AN OPTICAL WIDE BAND DATA TRANSMISSION SYSTEM
M. Nakamura, B. Leskovar, and B. T. Turko Jul. 1987 10 p Presented at the Nuclear Science Symposium, San Francisco, Calif., 21 Oct. 1987
(Contracts DE-AC03-76SF-00098; W-7405-eng-48)
(DE88-003854; LBL-23817; CONF-871006-33) Avail: NTIS HC A02

The signal processing for an optical wide band transmission system using gallium arsenide (GaAs) digital integrated circuits and optical fibers has been investigated. Multiplexing, coding, synchronization, demultiplexing, and error checking at 780 Mbit/s data rates are described. Data storage in memory for linking to a computer is also considered. The design uses available GaAs and silicon components. The reliability of GaAs components is discussed as well as the layout and thermal considerations required for a high speed system. DOE

N88-17889# California Univ., Berkeley. Lawrence Berkeley Lab.
WIDE BAND DATA TRANSMISSION SYSTEM USING OPTICAL FIBERS
B. Leskovar, M. Nakamura, and B. T. Turko Apr. 1987 10 p Presented at the Nuclear Science Symposium, San Francisco, Calif., 21 Oct. 1987
(Contracts DE-AC03-76SF-00098; W-7405-eng-48)
(DE88-004555; LBL-23304; CONF-871006-32) Avail: NTIS HC A02

An ultra high speed data transmission system using optical fibers and gallium arsenide digital integrated circuits has been investigated. The system is designed to meet the increased data rate requirements of modern information processing systems as well as those of future imaging devices and high spatial resolution detectors. A description of the system which uses available components made for the transmission and reception of data at 780 Mbit/s rates is given. Methods for digitizing, multiplexing, demultiplexing, error checking, etc., are also described, and a discussion of the reliability of components is presented. DOE

N88-17890*# Jet Propulsion Lab., California Inst. of Tech., Pasadena.
SATELLITE INTERFERENCE ANALYSIS AND SIMULATION USING PERSONAL COMPUTERS
Anil Kantak 1 Mar. 1988 50 p
(Contract NAS7-918)
(NASA-CR-182522; JPL-Publ-88-3; NAS 1.26:182522) Avail: NTIS HC A03/MF A01 CSCL 20N

This report presents the complete analysis and formulas necessary to quantify the interference experienced by a generic satellite communications receiving station due to an interfering

satellite. Both satellites, the desired as well as the interfering satellite, are considered to be in elliptical orbits. Formulas are developed for the satellite look angles and the satellite transmit angles generally related to the land mask of the receiving station site for both satellites. Formulas for considering Doppler effect due to the satellite motion as well as the Earth's rotation are developed. The effect of the interfering-satellite signal modulation and the Doppler effect on the power received are considered. The statistical formulation of the interference effect is presented in the form of a histogram of the interference to the desired signal power ratio. Finally, a computer program suitable for microcomputers such as IBM AT is provided with the flowchart, a sample run, results of the run, and the program code. Author

N88-17891*# Jet Propulsion Lab., California Inst. of Tech., Pasadena.
THE DESIGN OF TRELLIS CODES FOR FADING CHANNELS
Dariush Divsalar and Marvin K. Simon 1 Nov. 1987 57 p
(Contract NAS7-918)
(NASA-CR-182523; JPL-Publ-87-39; NAS 1.26:182523) Avail: NTIS HC A04/MF A01 CSCL 20N

The appropriate criterion for optimum trellis coded modulation design on the additive white Gaussian noise channel is maximization of the free Euclidean distance. When trellis coded modulation is used on a Rician fading channel with interleaving/deinterleaving, the design of the code for optimum performance is guided by other factors, in particular the length of the shortest error event path, and the product of branch distances (possibly normalized by the Euclidean distance of the path) along that path. Although maximum free distance (d sub free) is still an important consideration, it plays a less significant role the more severe the fading is on the channel. These considerations lead to the definition of a new distance measure for optimization of trellis codes transmitted over Rician fading channels. If no interleaving/deinterleaving is used, then once again the design of the trellis code is guided by maximizing d sub free. It is also shown that allowing for multiple symbols per trellis branch, i.e., multiple trellis coded modulation (MTCM), provides an additional degree of freedom for designing a code to meet the above optimization criteria on the fading channel. It is here where the MTCM technique exploits its full potential. Author

N88-17892*# Arizona Univ., Tucson. Optical Sciences Center.
GUIDED-WAVE APPROACHES TO SPECTRALLY SELECTIVE ENERGY ABSORPTION Final Report, 25 Jan. 1983 - 2 Mar. 1987
G. I. Stegeman and J. J. Burke Mar. 1987 14 p
(Grant NAG3-392)
(NASA-CR-182532; NAS 1.26:182532) Avail: NTIS HC A03/MF A01 CSCL 20N

Results of experiments designed to demonstrate spectrally selective absorption in dielectric waveguides on semiconductor substrates are reported. These experiments were conducted with three waveguides formed by sputtering films of PSK2 glass onto silicon-oxide layers grown on silicon substrates. The three waveguide samples were studied at 633 and 532 nm. The samples differed only in the thickness of the silicon-oxide layer, specifically 256 nm, 506 nm, and 740 nm. Agreement between theoretical predictions and measurements of propagation constants (mode angles) of the six or seven modes supported by these samples was excellent. However, the loss measurements were inconclusive because of high scattering losses in the structures fabricated (in excess of 10 dB/cm). Theoretical calculations indicated that the power distribution among all the modes supported by these structures will reach its steady state value after a propagation length of only 1 mm. Accordingly, the measured loss rates were found to be almost independent of which mode was initially excited. The excellent agreement between theory and experiment leads to the conclusion that low loss waveguides confirm the predicted loss rates. Author

N88-17893# Massachusetts Inst. of Tech., Cambridge. Research Lab. of Electronics.
SPEECH RECOGNITION: ACOUSTIC-PHONETIC KNOWLEDGE ACQUISITION AND REPRESENTATION Report, 1 Oct. 1986 - 30 Sep. 1987
Victor W. Zue 24 Sep. 1987 9 p
(Contract N00014-82-K-0727)
(AD-A187293) Avail: NTIS HC A02/MF A01 CSCL 05G

A long-term research goal is the development and implementation of speaker-independent continuous speech recognition systems. It is believed that the proper utilization of speech-specific knowledge is essential for such advanced systems. Research is thus directed toward the acquisition of acoustic-phonetic and lexical knowledge, and the application of this knowledge to speech recognition algorithms. Investigation into the contextual variations of speech sounds has continued, emphasizing the role of the syllable in these variations. Analysis revealed that the acoustic realization of a stop depends greatly on its position within a syllable. In order to represent and utilize this information in speech recognition, a hierarchical syllable description has been adopted that enables us to specify the constraints in terms of an immediate constituent grammar. We will continue to quantify the effect of context on the acoustic realization of phonemes using larger constituent units such as syllables. In addition, a grammar will be developed to describe the relationship between phonemes and acoustic segments, and a parser that will make use of this grammar for phonetic recognition and lexical access. GRA

N88-17894# Naval Research Lab., Washington, D.C.
DETECTION OF SIGNALS IN NON-GAUSSIAN CORRELATED NOISE DERIVED FROM CAUCHY PROCESSES Interim Report
Ben Cantrell 14 Oct. 1987 25 p
(AD-A187488; NRL-9086) Avail: NTIS HC A03/MF A01 CSCL 17I

A new processor for detecting a radar target in correlated, non-Gaussian noise is obtained. When this processor and a matched filter are excited with this noise, performance is improved over that of the matched filter alone. The processor is obtained by developing an approximate, bivariate, probability density for the noise and constructing a Neyman Pearson test and then using an approximation to the likelihood ratio obtained from the Neyman Pearson test. The bivariate density was constructed from an underlying Cauchy process and matches the true bivariate density only in the marginals and first two moments. GRA

N88-17895# Naval Ocean Systems Center, San Diego, Calif.
THE DESIGN OF IMPEDANCE- MATCHING NETWORKS FOR BROADBAND ANTENNAS Final Report
S. T. Li and D. W. Tam Sep. 1987 84 p
(AD-A187600; NOSC-TD-1148) Avail: NTIS HC A05/MF A01 CSCL 09A

An interactive BASIC language computer program to aid in the design of a matching network for a broadband antenna is described. Guidelines for the design of a broadband matching network are presented. The Antenna Matching (ANTMAT) program provides a computer-aided design tool for determining network topology and component values of the networks. It improves the speed and accuracy of the broadband matching network design procedures. An optimization algorithm finds the values of the components that minimize the input reflection coefficient. At first, the optimization algorithm with an exponential weighting function is employed for determining a list of network candidates (either a pi network or a T network) from which a network topology is selected. After a topology is specified, the optimization algorithm with other weighting function is used for finding optimum element values. GRA

N88-17896# San Diego State Univ., Calif.
SIGNAL PROCESSING STUDIES PROGRAM OPTICAL SIGNAL AMPLIFICATION, VOLUME 2 Final Report, Jun. - Sep. 1986
R. Cromwell Sep. 1987 24 p Prepared in cooperation with Arizona Univ., Tucson
(Contract N66001-85-D-0203)

(AD-A188054; NOSC-TD-1161-Vol-2) Avail: NTIS HC A03/MF A01 CSCL 09A

The primary tasks associated with the contract were characteristics and calibration of an RCA 8852 photomultiplier tube and a Varo intensifier. The photomultiplier was characterized by its spectral response, absolute sensitivity, quantum efficiency, scan uniformity, dark current temperature, pulse-height distribution, and noise figure. The Varo intensifier was characterized by its response as a function of bias voltage both in the dark and while irradiated by an LED light source. This final report discusses the tests performed and compares them with data in the open literature and with data obtained by means of private communication from other researchers in the field. Some tests are also discussed is the bimonthly report covering the period from June 26. 1986 to August 26, 1986. GRA

N88-17897# San Diego State Univ., Calif.
SIGNAL PROCESSING STUDIES PROGRAM OPTICAL SIGNAL AMPLIFICATION, VOLUME 1 Final Report, Jun. - Sep. 1986
H. Roehrig and M. Browne Sep. 1987 24 p Prepared in cooperation with Arizona Univ., Tucson
(Contract N66001-85-D-0203)
(AD-A188055; NOSC-TD-1161-Vol-1) Avail: NTIS HC A03/MF A01 CSCL 09A

The primary tasks associated with this contract were characterization and calibration of an RCA 8852 photomultiplier tube and a Varo image intensifier. The photomultiplier was characterized by its spectral response, absolute sensitivity, quantum efficiency, scan uniformity, dark current vs temperature, pulse-height distribution, and noise figure. The Varo intensifier was characterized by its response as a function of bias voltage both in the dark and while irradiated by an LED light source. This final report discusses the tests performed and compares them with data in the open literature and with data obtained by means of private communication from other researchers in the field. Some tests are also discussed in the bimonthly report covering the period from June 26, 1986 to August 25, 1986. GRA

N88-17898# Naval Surface Weapons Center, Silver Spring, Md.
FUNDAMENTAL CYCLOTRON FREQUENCY GENERATION FROM A CUSPTRON OSCILLATOR Final Report
W. Namkung, J. Y. Choe, H. S. Uhm, and V. Ayres 1 Aug. 1987 13 p
(AD-A188187; NSWC/TR-87-268) Avail: NTIS HC A03/MF A01 CSCL 09A

The first experiment is reported for microwave generation of the fundamental electron cyclotron frequency from a cusptron oscillator with a smooth conducting wall. A non relativistic axis-rotating electron beam is used to generate the TE sub 11 circular modes in a cavity by the negative mass instability. The TE sub 111 and TE sub 112 modes are separately excited without any mode competition at an approximately 1.8 kW output power with 7.8 percent efficiency. GRA

N88-17899*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.
COMPLEMENTARY SATELLITE SOUND BROADCASTING SYSTEMS: A NASA ASSESSMENT FOR THE VOICE OF AMERICA
Grady H. Stevens and Rodney L. Spence Jan. 1988 84 p
(NASA-TM-100300; E-3948; NAS 1.15:100300) Avail: NTIS HC A05/MF A01 CSCL 17B

Satellite concepts are examined which offer potentially significant sound broadcast coverage of audio as a complement to VOA's existing and planned terrestrial sound broadcasting system. HF bands are emphasized but additional discussion is included for systems using higher frequencies. Low altitude satellites, shuttle altitude (275 km) and sun synchronous (about 1600 to 1800 km), would not be practical for international broadcasting since many satellites would be required for reliable and widespread coverage. Two concepts are discussed which would offer significant and practical broadcast coverage at HF. One, an 8-hr posigrade equatorial orbit, would offer about 1 hr of widespread, twice daily, coverage to three areas of the globe. The time of coverage is even greater when confined to densely populated areas only (2 to 3 hrs). Another orbit, the Apogee at Constant Time/Equatorial (ACE), provides the same coverage, but only once daily to each area. The latter orbit is highly elliptical, allowing insertion of a greater payload (more broadcast channels) with the existing launch capability. The ACE and 8-hr orbit concepts led to systems of about equal costs, with the ACE being slightly better. Author

N88-17623*# Environmental Research Inst. of Michigan, Ann Arbor. Radar Science Lab.
RADAR BACKSCATTER FROM AIRPORTS AND SURROUNDING AREAS
Robert G. Onstott *In* NASA. Langley Research Center, Airborne Wind Shear Detection and Warning Systems: First Combined Manufacturers and Technologists Conference Jan. 1988 p 183-191 (For primary document see N88-17616 10-03)
Avail: NTIS HC A24/MF A01 CSCL 17B

N88-17624*# Northeastern Univ., Boston, Mass.
RADAR RETURNS FROM GROUND CLUTTER IN VICINITY OF AIRPORTS
H. R. Raemer, R. Rahgavan, and A. Bhattacharya *In* NASA. Langley Research Center, Airborne Wind Shear Detection and Warning Systems: First Combined Manufacturers and Technologists Conference Jan. 1988 p 193-205 (For primary document see N88-17616 10-03)
Avail: NTIS HC A24/MF A01 CSCL 17B

N88-17625*# Research Triangle Inst., Hampton, Va.
WIND SHEAR RADAR SIMULATION
Charles L. Britt *In* NASA. Langley Research Center, Airborne Wind Shear Detection and Warning Systems: First Combined Manufacturers and Technologists Conference Jan. 1988 p 207-231 (For primary document see N88-17616 10-03)
Avail: NTIS HC A24/MF A01 CSCL 17B

N88-17632*# Massachusetts Inst. of Tech., Lexington.
STATUS OF FAA TERMINAL DOPPLER WEATHER RADAR PROGRAMS
Mark W. Merritt *In* NASA. Langley Research Center, Airborne Wind Shear Detection and Warning Systems: First Combined Manufacturers and Technologists Conference Jan. 1988 p 411-444 (For primary document see N88-17616 10-03)
Avail: NTIS HC A24/MF A01 CSCL 17I

N88-17693*# Marshall Amateur Radio Club, Huntsville, Ala.
MARCE DATA EVALUATION
Edward F. Stluka *In* NASA. Goddard Space Flight Center, The 1987 Get Away Special Experimenter's Symposium Feb. 1988 p 9-16 (For primary document see N88-17691 10-12)
Avail: NTIS HC A08/MF A01 CSCL 17B

N88-17855# Messerschmitt-Boelkow-Blohm G.m.b.H., Ottobrunn (West Germany). Unternehmensgruppe Wehrtechnik.
ROTOR SAR (ROSAR): A NEW HIGH-RESOLUTION ALL-WEATHER VISION METHOD FOR HELICOPTERS [ROSAR - EIN NEUES HOCHAUFLOESENDES ALLWETTERSICHTVERFAHREN FUER HUBSCHRAUBER]
Horst Kaltschmidt and Helmut Klausing (Deutsche Forschungs- und Versuchsanstalt fuer Luft- und Raumfahrt, Oberpfaffenhofen, West Germany) *In its* Research and Development. Technical-Scientific Publications (1956-1987): Retrospective View and Prospects. Jubilee Edition on the Occasion of the 75th Anniversary of Dipl.-Engr. Dr.-Engr. E.H. Ludwig Boelkow 1987 p 235-240 In GERMAN (For primary document see N88-17819 10-31)
(MBB-UA-1046/87) Copyright Avail: NTIS HC A14/MF A01

N88-17864# Messerschmitt-Boelkow-Blohm G.m.b.H., Ottobrunn (West Germany). Unternehmensgruppe Wehrtechnik.
EXPERIMENTS FOR THE HIGH RESOLUTION DETECTION OF MOVING TARGETS USING A CO2 LASER RADAR [EXPERIMENTE ZUR HOCHAUFGELOESTEN ERFASSUNG VON VEWEGTZIELEN MIT EINEM CO2-LASER-RADAR]
Armin Breinig *In its* Research and Development. Technical-Scientific Publications (1956-1987): Retrospective View and Prospects. Jubilee Edition on the Occasion of the 75th Anniversary of Dipl.-Engr. Dr.-Engr. E.H. Ludwig Boelkow 1987 p 293-296 In GERMAN (For primary document see N88-17819 10-31)
(MBB-UA-1044/87) Copyright Avail: NTIS HC A14/MF A01

33 ELECTRONICS AND ELECTRICAL ENGINEERING

Includes test equipment and maintainability; components, e.g., tunnel diodes and transistors; microminiaturization; and integrated circuitry.

For related information see also *60 Computer Operations and Hardware* and *76 Solid-State Physics.*

N88-17900# Old Dominion Univ., Norfolk, Va.
MAGNETIC CONTROL OF LOW PRESSURE DISCHARGES Annual Report
Karl H. Schoenbach Aug. 1987 69 p
(Contract N00014-85-K-0602)
(AD-A186794) Avail: NTIS HC A04/MF A01 CSCL 09E

In abnormal glow discharges, operated in electronegative gas mixtures, the discharge resistance can be increased by the application of a transverse magnetic field. This effect is caused by a shift of the electron energy distribution towards lower energies. In the positive column of the discharge this leads to reduction of electron drift velocity and ionization rate, and for certain attachers, an increase of the attachment rate and consequently to an increase of the resistivity. A coaxial discharge system was used to study the steady-state and transient behavior of abnormal glow discharges in a He:SF6 gas mixture in transverse magnetic fields. The steady-state current characteristics were measured for current densities of 1 A cm2 and an interelectrode distance of 2 cm, the discharge voltage was found to increase with a rate of 2 kV Tesla, corresponding to an increase of electric field intensity of 1 kV Tesla cm. GRA

N88-17901# Salford Univ. (England). ISIM Simulation Div.
ESL BATTERIES AND MULTI-SEGMENT APPLICATIONS Final Report
J. L. Hay, J. G. Pearce, L. Turnbull, and J. R. Owen Paris, France ESA Jun. 1987 100 p
(Contract ESA-6466/85-NL-MA)
(CS-1029/00-QFIN4; ESA-CR(P)-2485; ETN-88-91699) Avail: NTIS HC A05/MF A01

A simulation model for nickel cadmium battery cells operating in the environment of a low Earth orbit satellite; simulation applications to investigate the performance of the ESA Simulation Language (ESL) segment or multiprocessor emulation features; a double-precision version of ESL; and development of ESL in equation sorting, segmentation, character handling, and file input/output are described. ESA

N88-17902# Allied Bendix Corp., Kansas City, Mo.
ION CHROMATOGRAPHY IN THE MANUFACTURE OF MULTILAYER CIRCUIT BOARDS
R. E. Smith Oct. 1987 11 p Presented at the Ion Chromatography Symposium in the Aerospace and Semiconductor Industries, Anaheim, Calif., 23 Sep. 1987
(Contract DE-AC04-76DP-00613)
(DE88-002428; BDX-613-3798; CONF-8709185-1) Avail: NTIS HC A03/MF A01

Ion chromatography (IC) has proven useful in analyzing chemical solutions used in the manufacture of multilayer circuit boards. IC provides results on ions not expected in the production solutions. Thus, solution contamination and breakdown products can be monitored in every phase of the circuit board manufacturing. During the first phase, epoxy laminates experience an etchback, first in chromic acid, which can be analyzed for trace chloride and sulfate, then in ammonium bifluoride/HCl, which can be analyzed for fluoride and chloride. Following a wet blasting to roughen up the surface, 20 mu in. of copper are deposited using an electroless bath. Again, IC is applicable for monitoring formate, tartarate, and sulfate levels. Next, an acid copper bath is used to electroplate the through holes with 0.001 in. of ductile copper. This bath is analyzed for trace chloride. Photoimaging is then performed, and the organic solvents used can be assayed for trace ionic chloride. Finally, a fluoroboric acid-based tin-lead bath is used to deposit a solderable alloy. This bath is analyzed for total fluoroborate, tin, and lead. In addition, mobile phase ion chromatography (MPIC) is used to monitor the nonionic organic brighteners in the baths. DOE

N88-17903# Sandia National Labs., Albuquerque, N. Mex.
AN ADAPTIVE FILTERING TECHNIQUE FOR REMOVING PERIODIC NOISE FROM MODAL RESPONSE DATA
M. D. Tucker 1987 7 p Presented at the 6th International Modal Analysis Conference, Orlando, Fla., 1 Feb. 1988
(Contract DE-AC04-76DP-00789)
(DE88-002347; SAND-87-1332C; CONF-880220-5) Avail: NTIS HC A02

In many modal tests, the dynamic response of the system is contaminated with periodic noise from sources such as pumps and motors that is not correlated with the excitation used to derive the frequency response functions. This paper describes an adaptive filtering technique to remove this noise from the response time history data. The output of the filter is a signal which contains only the modal response of the system that is correlated with the input excitation force. In addition to the theory of this technique, practical examples are also presented to verify the method. DOE

N88-17904# Gosudarstvennyj Komitet po Ispolzovaniyu Atomnoi Energii, Serpukhov (USSR). Inst. Fiziki Vysokikh Ehnergij.
ON THE CHOICE OF A ELEMENT LOW-NOISE PREAMPLIFIER ON BIPOLAR TRANSISTORS
R. N. Krasnokutskij, L. L. Kurchaninov, V. V. Tikhonov, N. N. Fedyakin, and R. S. Shuvalov 1986 10 p In RUSSIAN
(DE88-700639; IFVE-ONF-86-217) Avail: NTIS (US Sales Only) HC A02/MF A01

The dependence of the preamplifier equivalent noise charge (ENC) on the detector capacitance, shaping time and collector current of the head transistor is presented. The measurement results are in a good agreement with calculations based on a simple noise model, so tedious ENC measurements may be replaced by a simple selection of transistors on distributed base resistance and current gain factor and unsophisticated calculations. Soviet KT382 - type transistors have the same noise performance as the best Japan transistors NE578 and NE021 and it is possible to use it as a head transistor for nuclear electronics applications. DOE

N88-17905# National Bureau of Standards, Gaithersburg, Md. Electricity Div.
SOLID-STATE VOLTAGE STANDARD PERFORMANCE AND DESIGN GUIDELINES Final Report
B. F. Field Sep. 1987 69 p
(PB88-123757; NBS/TN-1239) Avail: NTIS HC A04/MF A01; also available SOD HC $1.50 as 003-003-02822-3 CSCL 09C

The Electricity Division has examined and analyzed the performance of all presently available high-quality solid-state (Zener) dc voltage standards. Based on these examinations and the author's knowledge of standard laboratory requirements, the authors have developed a set of guidelines to define what is needed in a modern solid-state standard to supplement or replace cadmium-sulfate standard cells. Specific design goals are presented to serve as a guide for writing a detailed solid-state voltage standard

specification, and also as a guide to anyone evaluating such a standard. GRA

N88-17906# Massachusetts Inst. of Tech., Cambridge.
INVESTIGATION OF MATERIALS FOR INERT ELECTRODES IN ALUMINUM ELECTRODEPOSITION CELLS
J. S. Haggerty and D. R. Sadoway 14 Sep. 1987 250 p
(Contract DE-FG07-83ID-12380)
(DE88-003380; DOE/ID-12380/18) Avail: NTIS HC A11/MF A01

Work was divided into major efforts. The first was the growth and characterization of specimens; the second was Hall cell performance testing. Cathode and anode materials were the subject of investigation. Preparation of specimens included growth of single crystals and synthesis of ultra high purity powders. Special attention was paid to ferrites as they were considered to be the most promising anode materials. Ferrite anode corrosion rates were studied and the electrical conductivities of a set of copper-manganese ferrites were measured. Float Zone, Pendant Drop Cryolite Experiments were undertaken because unsatisfactory choices of candidate materials were being made on the basis of a flawed set of selection criteria applied to an incomplete and sometimes inaccurate data base. This experiment was then constructed to determine whether the apparatus used for float zone crystal growth could be adapted to make a variety of important based melts and their interactions with candidate inert anode materials. Compositions), driven by our perception that the basis for prior selection of candidate materials was inadequate. Results are presented. DOE

N88-17907# Brookhaven National Lab., Upton, N. Y.
DESIGN OF A CHARGE SENSITIVE PREAMPLIFIER ON HIGH RESISTIVITY SILICON
V. Radeka, P. Rehak, S. Rescia, E. Gatti, A. Longoni, M. Sampietro, P. Holl, L. Strueder, and J. Kemmer 1987 6 p Presented at the Nuclear Science Symposium, San Francisco, Calif., 21 Oct. 1987 Prepared in cooperation with Politecnico di Milano. Italy; Max-Planck-Inst. fuer Physik und Astrophysik, Munic, Fed. Republic of Germany and Technische Univ., Munich, Fed. Republic of Germany
(Contract DE-AC02-76CH-00016)
(DE88-003491; BNL-40464; CONF-871006-20) Avail: NTIS HC A02

A low noise, fast charge sensitive preamplifier was designed on high resistivity, detector grade silicon. It is built at the surface of a fully depleted region of n-type silicon. This allows the preamplifier to be placed very close to a detector anode. The preamplifier uses the classical input cascode configuration with a capacitor and a high value resistor in the feedback loop. The output stage of the preamplifier can drive a load up to 20pF. The power dissipation of the preamplifier is 13mW. The amplifying elements are Single Sided Gate JFETs developed especially for this application. Preamplifiers connected to a low capacitance anode of a drift type detector should achieve a rise time of 20ns and have an equivalent noise charge (ENC), after a suitable shaping, of less than 50 electrons. This performance translates to a position resolution better than 3 microns for silicon drift detectors. DOE

N88-17908# Los Alamos National Lab., N. Mex.
A RING MODEL OF THE LASERTRON
P. J. Tallerico and J. P. Coulon Jan. 1988 25 p
(Contract W-7405-eng-36)
(DE88-004656; LA-11189-MS) Avail: NTIS HC A03/MF A01

A large-signal, 2-1/2 dimensional relativistic particle dynamics code has been written to simulate the electrical behavior of the lasertron. The theory and the approximations involved in this code are discussed in detail. Numerical results are presented to show the comparison with previous work and to show the general variation in lasertron performance with frequency, beam voltage, and beam current. The code has also been used to design a prototype 6 GHz lasertron for construction at the Laboratoire de l'Accelerateur Lineaire in Orsay, France. The calculations show that this prototype can produce 4.7 MW peak-power output with a conversion efficiency of 65 percent. At 3 GHz, the power would be increased by a factor approaching 10, and the conversion efficiency would be over 70 percent. DOE

N88-17909# Los Alamos National Lab., N. Mex.
THERMAL ANALYSIS OF TRANSISTOR PACKAGES, PART 2
G. A. Bennett and T. H. Larkin Nov. 1987 23 p
(Contract W-7405-eng-36)
(DE88-005091; LA-10905-MS-Pt-2) Avail: NTIS HC A03/MF A01

Good thermal design is essential for improving the efficiency and the high-temperature capabilities of microwave power transistors. To improve thermal performance and to enhance reliability, a systematic study quantified transistor package thermal behavior. A series of two-dimensional finite element thermal analyses was completed of a transistor using several sets of boundary conditions. These analyses provide indications for the temperature field and internal thermal resistance components as a function of the imposed boundary conditions, material properties, and geometry. Results from the analyses are shown as isothermal contour plots, plots of temperature drop across the flange and carrier, and plots of temperature versus time. DOE

N88-17910# National Bureau of Standards, Gaithersburg, Md. Semiconductor Electronics Div.
EFFECT OF THE GATE OXIDE THICKNESS ON THE SPEED OF MOS INTEGRATED CIRCUITS
J. S. Kim Dec. 1987 19 p
(PB88-155783; NBSIR-87/3668) Avail: NTIS HC A03/MF A01 CSCL 09A

A simple analysis is presented for the effect of the gate oxide thickness on the circuit speed in a short channel CMOS/inverter delay circuit. The analysis is performed within the first-order theory of the MOS transistor. The result of the analysis shows that an optimum value of the gate oxide thickness exists, beyond which a further scaling of the gate oxide will not improve but degrade the circuit speed. The circuit speed corresponding to this optimum oxide thickness is the ultimate upper limit theoretically possible in a given MOS integrated circuit. The optimum value of the gate oxide thickness, to the first order approximation, is proportional to the channel width W, but it is independent of the channel length L. In particular, for wide channel devices, this optimum value exceeds the 5 nm to 30 nm range, which is of practical significance in the design and processing of advanced VLSI circuits. Author

N88-17911# Oak Ridge National Lab., Tenn.
JOHNSON NOISE THERMOMETER FOR HIGH RADIATION AND HIGH TEMPERATURE ENVIRONMENTS
L. C. Oakes and R. L. Shepard 1988 23 p Presented at the 5th Symposium on Space Nuclear Power Systems, Albuquerque, N. Mex., 11 Jan. 1988
(Contract DE-AC05-84OR-21400)
(DE88-003770; CONF-880122-5) Avail: NTIS HC A03/MF A01

The purpose of development work on the Johnson noise power thermometer (JNPT) was to apply the work of Nyquist, who showed that the mean-squared noise voltage spectrum appearing across an unloaded resistor of value R is given by anti e sub n (2) = 4hfR (exp(hf/kT) - 1)) where anti e sub n (2) has the units volts squared per unit frequency, and h and k are the Planck and Boltzmann constants, respectively, f is the frequency in hertz (Hz) and T is the absolute temperature in Kelvins (K). J.B. Johnson showed that the noise was independent of the composition of the resistor. These discoveries gave rise to a temperature measurement technique using the Johnson noise voltage and Johnson noise current in a noise power mode, which essentially gives immunity to the decalibrating effects of radiation-induced transmutations of the temperature-sensing element. Experiments have been conducted in which temperature measurements were made in the range from 300 to 1200 K. Extrapolation of plots of these data pass through absolute zero, as expected. In-pile irradiation experiments show no perceptible decalibration after 4500 h in

high neutron flux even though 80 percent of the original sensor material, rhenium, had been transmuted to osmium. DOE

N88-17912# California Univ., Berkeley. Lawrence Berkeley Lab.
LOW-NOISE CRYOGENICALLY COOLED BROAD-BAND MICROWAVE PREAMPLIFIERS
B. Leskovar Apr. 1987 14 p Presented at the Low Temperature Electronics Symposium, Honolulu, Hawaii, 18 Oct. 1987
(Contract DE-AC03-76SF-00098)
(DE88-004561; LBL-23286; CONF-871072-1) Avail: NTIS HC A03/MF A01

The present noise performance, bandwidth capability and gain stability of low-noise cryogenically cooled broad-band preamplifiers are summarized and reviewed in the 150 MHz to 4 GHz frequency range. Stability factor of Gallium Arsenide Field-Effect transistors as a function of frequency and ambient temperature is presented and discussed. Also, other performance data, such as gain nonuniformity, phase shift as a function of frequency, and voltage standing-wave ratio, of several low-noise wide-band preamplifiers of interest for research instrumentation systems are presented. DOE

N88-17913# Ballistic Research Labs., Aberdeen Proving Ground, Md.
PULSED CURRENT TRANSFORMER FOR LOW INDUCTIVE LOADS
Alex Zielinski, Keith Jamison, and John Bennett Oct. 1987 46 p
(AD-A187224; BRL-MR-3626) Avail: NTIS HC A03/MF A01 CSCL 10B

At the US Army Research, Development and Engineering Command (ARDEC), an effort was undertaken to couple an array of five capacitor banks to a low inductance load. To achieve currents which exceed the limit placed on the capacitor banks, pulse current transformers were used. This power system, termed CAPSTAR, was ultimately used to electromagnetically stress a round bore composite railgun barrel section. A mathematical model has been developed to simulate a capacitor power supply driving a pulse transformer with various secondary loads. The model was first tested by comparison to experimental results using a subscale pulse transformer. The calculated data points were in good agreement with the experiment. Minor adjustments to some circuit parameters to account for the transitory behavior of the circuit are described. GRA

N88-17914# Rensselaer Polytechnic Inst., Troy, N.Y. Dept. of Mechanical Engineering, Aerospace Engineering and Mechanics.
ADVANCED ENERGY CONVERSION CONCEPT FOR BEAMED-ENERGY PROPULSION Final Report, Sep. 1984 - Nov. 1986
Leik N. Myrabo 21 Aug. 1987 197 p
(Grant AF AFOSR-0361-84)
(AD-A187336; RPI-5-24170; AFOSR-87-1387TR) Avail: NTIS HC A09/MF A01 CSCL 09C

Basic research was performed on an innovative power conversion concept for trans atmospheric, beamed energy propulsion: a new class of External Surface Impulse (ESI) thrusters. This advanced thruster principle could be used for atmospheric VTOL, high acceleration, and lateral flight (e.g., short-term cruise) propulsion of Single-Stage-To-Orbit (SSTO) beam-powered shuttlecraft of the next century. Three classes of ESI thrusters were initially examined: (1) simple thermal, (2) electrostatic, and (3) electromagnetic. Beam power wavelengths from 10 cm (microwave) to 0.3 micron (laser) were considered. The subsequent effort concentrated on the simple thermal repetitively-pulsed ESI thrusters, energized with laser power and using air as the working fluid. Laser frequencies were selected because of the relative wealth of experimental data and theoretical research on laser impulse coupling existing in the literature. The first year analytical effort has proven conclusively that such an engine can deliver high levels of thrust-to-beam-power at liftoff (e.g., at least an order of magnitude greater than beam-powered hydrogen-fueled rockets), with infinite specific impulse (decreased only, perhaps, by ablation of the thruster surface). Later along an orbital trajectory, the primary propulsion function would transition to other modes; upon leaving the atmosphere, the SSTO vehicle would continue in a pure rocket mode. GRA

N88-17915# Maryland Univ., College Park.
LOCAL BIFURCATION CONTROL
Eyad H. Abed 1987 29 p
(Grants AF AFOSR-0073-87; NSF CDR-85-00108)
(AD-A187435; AFOSR-87-1443TR) Avail: NTIS HC A03/MF A01 CSCL 25E

Local feedback stabilization of bifurcated solution branches is studied. Two cases are considered: that in which the nominal system undergoes a Hopf bifurcation as a parameter is varied, and the case of a stationary bifurcation from a simple zero eigenvalue. For each case, results on the existence of a stabilizing feedback are given. Moreover, simple synthesis techniques for the stabilizing controllers are discussed. A concept of proximity stabilization is introduced as an alternative to stabilization in the ordinary sense for systems that are not locally stabilizable. A result is stated on the generic character of proximity stabilizability. Motivation for further research in several areas is given. GRA

N88-17916# Massachusetts Inst. of Tech., Cambridge. Research Lab. of Electronics.
TIME DOMAIN WAVE PROPAGATION IN MULTILAYERED INTEGRATED CIRCUITS Semiannual Report, 1 Feb. - 31 Jul. 1987
Jin A. Kong 31 Jul. 1987 8 p
(Contract N00014-86-K-0533)
(AD-A187462) Avail: NTIS HC A02/MF A01 CSCL 09A

The analysis of resonance, input impedance and radiation of the elliptic disk, microstrip structure is rigorously formulated in this paper, using the Scalar and Vector Mathieu Transforms. With the help of these transforms, the resonance frequencies of the structure can be derived exactly using Galerkin's method and approximately using a perturbational approach. Expressions for the input impedance and the radiation pattern are also obtained. Theory for quasi-TEM modes propagating in a transversely inhomogeneous (multi-dielectric) longitudinally uniform transmission line, previously derived for time-harmonic waves, is derived for transient signals. While the starting point for the theory is completely different, the result is similar to the time-harmonic theory, and previously derived properties for propagating modes also apply in the transient case. The range of applicability is discussed with a simple example. Exact image method, recently introduced for the solution of electromagnetic field problems involving sources above a planar interface between two homogeneous media, is shown to be valid also for sources located in complex space, which makes its application possible for Gaussian beam analysis. GRA

N88-17917# Aeronautical Research Labs., Melbourne (Australia).
OPERATORS MANUAL FOR A COMPUTER CONTROLLED IMPEDANCE MEASUREMENT SYSTEM
J. Gordon Feb. 1987 33 p
(AD-A187513; ARL-STRUC-TM-458; DODA-AR-004-522) Avail: NTIS HC A03/MF A01 CSCL 14B

Operating instructions of a computer controlled impedance measurement system based in Hewlett Packard instrumentation are given. Hardware details, program listings, flowcharts and a practical application are included. GRA

N88-17918# Massachusetts Inst. of Tech., Cambridge. Artificial Intelligence Lab.
FORMAL MULTILEVEL HIERARCHICAL VERIFICATION OF SYNCHRONOUS MOS VLSI CIRCUITS
Daniel W. Weise Jun. 1987 170 p
(Contracts N00014-86-K-0180; N00014-85-K-0124)
(AD-A187532; AI-TR-978) Avail: NTIS HC A08/MF A01 CSCL 09A

A system for the multilevel verification of synchronous MOS VLSI circuits has been designed and implemented. The system, called Silica Pithecus, accepts the schematic of an MOS circuit and a specification of the circuit's intended digital behavior. Silica Pithecus determines if the circuit meets its specification. If the circuit fails to meet its specification Silica Pithecus returns to the designer the reason for the failure. Unlike earlier verifiers which modelled primitives (e.g., transistors) as unidirectional digital devices, Silica Pithecus models primitives more realistically. Transistors are modelled as bidirectional devices of varying resistances, and nodes are modelled as capacitors. Silica Pithecus operates hierarchically, interactively, and incrementally. Major contributions of this research include a formal understanding of the relationship between different behavioral descriptions (e.g., signal, boolean, and arithmetic descriptions) of the same device, and a formalization of the relationship between the structure, behavior, and a context of a device. Given these formal structures, these methods find sufficient conditions on the inputs of circuits which guarantee the correct operation of the circuit in the desired descriptive domain. These methods are algorithmic and complete. They also handle complex phenomena such as races and charge sharing. Informal notions such as races and hazards are shown to be derivable from the correctness conditions used by these methods. GRA

N88-17919# Air Force Inst. of Tech., Wright-Patterson AFB, Ohio.
THE SOFT/HARD WET ANODIZATION OF ALUMINUM OXIDE AND ITS USE IN A THIN FILM MULTILAYERED CAPACITOR M.S. Thesis
John R. Dickey 1986 152 p
(AD-A187575; AFIT/CI/NR-87-90T) Avail: NTIS HC A08/MF A01 CSCL 07D

Literature has identified and characterized the existence of barrier and porous alumina formed by the electrolytic anodization of aluminum. Barrier films are limited in thickness by the formation voltage, found to be typically 12 to 15 A/volt. Porous layers may be formed thicker without such limitation. In this work, anodization was performed on vacuum or sputter deposited aluminum films typical of those used for interconnect metal for integrated circuits. Substrates were thermally oxidized silicon wafers. The anodization consisted of a two step operation. A layer of soft anodized consisted of a two step operation. A layer of soft anodized aluminum was first formed using sulfuric acid electrolyte. This anodized layer was then subjected to a boric acid hard anodization. Single level and multilevel capacitor structures were formed and dielectric evaluation performed. Effective dielectric contents of up to approximately 70, volume resistivities of up to 1.2x10 to the 18th power ohm-cm and breakdown voltages of up to 2.38 times that of the hard anodization forming voltage were observed. Cleaved SEM cross sections were examined and indicated a dense amorphous alumina layer was formed. GRA

N88-17920# Harvard Univ., Cambridge, Mass. Div. of Applied Sciences.
JOINT SERVICES ELECTRONICS PROGRAM Annual Progress Report No. 101, 1 Jan. - 1 Oct. 1987
M. Tinkham 30 Sep. 1987 84 p
(Contract N00014-84-K-0465)
(AD-A187587) Avail: NTIS HC A05/MF A01 CSCL 09A

An annual report of the JSEP (Joint Services Electronics Program) in solid state electronics, quantum electronics, information electronics, control and optimization, and electromagnetic phenomena is presented. Results of the research to date are summarized and significant accomplishments discussed. GRA

N88-17921# Stanford Univ., Calif. Center for Reliable Computing.
LATENT FAILURES AND COVERAGE IN FAULT-TOLERANT SYSTEMS. A VLSI CMOS CIRCUIT DESIGN TECHNIQUE TO AID TEST GENERATION
Hassanein H. Amer and Edward J. McCluskey Dec. 1986 12 p
(Contract MDA903-83-C-0335; Grant NSF DCR-82-00129)
(AD-A187615; CRC-TR-86-18) Avail: NTIS HC A03/MF A01 CSCL 09A

This report on fault-tolerant systems contains the following: Latent Failures and Coverage in Fault-Tolerant Systems; and A VLSI CMOS Circuit Design Technique to Aid Test Generation. GRA

N88-17922# San Diego State Univ., Calif.
SIGNAL PROCESSING STUDIES PROGRAM VLSI DESIGNS FOR UNARY FUNCTIONS Interim Report, Jan. 1987
J. H. Harris Sep. 1987 57 p
(Contract N66001-85-D-0203)
(AD-A188053; NOSC-TD-1162) Avail: NTIS HC A04/MF A01 CSCL 12A

Use of engineering workstations greatly facilitates the design of special purpose (application specific) electronic circuits of VLSI level complexity. With a view toward the likely need for special purpose chips for future high performance signal processing applications, an examination into the nature of the enhancement in efficiency provided by a competitive workstation was conducted using the Chipmaster software available on a Daisy workstation. Layout of an on-line arithmetic circuit was performed. The circuit implements an algorithm for computing 1/X where X is the binary input to the circuit. On-line refers to arithmetic methods in which the results of computations are obtained in the form of a sequence of digits with the most significant digit obtained first and succeeding digits obtained in turn. On-line algorithms have been developed by Ercegovac, the logic level circuit used in the study was generated by Henderson, and the effort was part of a broader study of systolic array signal processing systems by Symanski. GRA

N88-17923# Massachusetts Inst. of Tech., Cambridge.
STUDY OF QUANTUM MECHANICAL EFFECTS IN DEEP SUBMICRON, GRATING-GATE FIELD EFFECT TRANSISTORS Annual Report, 30 Sep. 1986 - 29 Sep. 1987
Dimitri A. Antoniadis and Henry I. Smith 29 Oct. 1987 8 p
(Grant AF AFOSR-0376-85)
(AD-A188283; AFOSR-87-1659TR) Avail: NTIS HC A02/MF A01 CSCL 09A

This research program investigates the effect of extreme submicron spatial modulation of the electrostatic potential on the transport in a two-dimensional electron gas (2DEG) in silicon and in III-V compound semiconductor devices. The test vehicle is the so-called grating-gate FET (GGFET). When made to move in a direction perpendicular to the grating gate, electrons experience a surface superlattice (SSL) effect. When moving along the potential modulation electrons are restricted to only one degree of freedom, and thus constitute a quasi-one-dimensional (Q1D) system. Our major achievements in the past year include: In silicon we have fabricated, with high yield, grating gate transistors and measured their current voltage characteristics at liquid helium temperatures. The device mobility at 4 K is about 15000 sq cm/Vs, possibly the highest reported for MOSFETs fabricated using e-beam or X-ray lithographies. GRA

34 FLUID MECHANICS AND HEAT TRANSFER

Includes boundary layers; hydrodynamics; fluidics; mass transfer; and ablation cooling.

For related information see also *02 Aerodynamics* and *77 Thermodynamics and Statistical Physics.*

N88-17924*# National Aeronautics and Space Administration. Langley Research Center, Hampton, Va.
LEESIDE CROSSFLOW MODELING IN EULER SPACE-MARCHING COMPUTATIONS
F. P. Baltakis, A. B. Wardlaw, Jr. (Naval Surface Weapons Center, Silver Spring, Md.), and J. M. Allen Nov. 1986 46 p Sponsored by NASA Langley Research Center, Hampton, Va.

(NASA-TM-89710; NAS 1.15:89710; AD-A175903;
NSWC/TR-86-342) Avail: NTIS HC A03/MF A01 CSCL 20D

A simple method was developed to model crossflow separation for inviscid (Euler type) computations by suppressing the crossflow velocity near the body surface. The method was validated for a tangent-ogive-cylinder body of circular cross section and shown to be useful at supersonic speeds at low to intermediate angles of incidence (M less than 5, alpha less than 20 deg). At low Mach numbers (M less than 3) the method offers a significant improvement in the inviscid leeside surface pressure distributions and also yields improved predictions of aerodynamic coefficients. The algorithm for a tangent-ogive-cylinder body is described and comparisons of numerical and experimental data are presented.
Author

N88-17925# Army Cold Regions Research and Engineering Lab., Hanover, N.H.

APPROXIMATE SOLUTIONS OF HEAT CONDUCTION IN A MEDIUM WITH VARIABLE PROPERTIES

Yin-Chao Yen Sep. 1987 31 p
(AD-A186933; CRREL-87-19) Avail: NTIS HC A03/MF A01
CSCL 20M

The approximate heat balance integral method (HBIM) is extended to the case of a medium with variable properties such as snow. The case of linear variation of thermal conductivity was investigated. An alternative heat balance integral method (AHBIM) was developed. Both constant surface temperature and surface heat flux were considered. A comparison was made of the temperature distribution from the HBIM, AHBIM and an analytical method for the case of constant surface temperature. In general, results agree quite well with the analytical method for small values of dimensionless time tau, but the difference becomes more pronounced as tau increases. It was found that the AHBIM with a quadratic temperature profile gave a somewhat better result, especially when the value of the dimensionless distance eta is small. For a specific property function of E(eta) = e eta, closed form solutions were obtained. The results, when compared with those from HBIM, AHBIM and the analytical method were found to agree exceptionally well with the analytical method, especially for large values of tau.
GRA

N88-17926# Texas A&M Univ., College Station. Ocean Engineering Program.

SPATIAL PRESSURE VARIATIONS AND THREE-DIMENSIONAL EFFECTS ON LIQUID SLOSHING LOADS Final Report, Oct. 1985 - Sep. 1987

Y. K. Lou and H. Choi Aug. 1987 117 p
(Contract DTMA91-85-C-50120)
(PB88-120134; COE-292; MA-RD-760-87039) Avail: NTIS HC
A06/MF A01 CSCL 20D

Liquid sloshing is an important problem for LNG carriers and large oil tankers because of their large tank size and the likelihood of near resonant excitation of the contained liquid. Under the previous research projects sponsored by the Maritime Administration, a numerical simulation technique was developed which is capable of predicting liquid impact pressures and forces on tank structures. However, the model is two dimensional; thus it is not adequate for three dimensional liquid sloshing problems.
Author

N88-17927# California Univ., Berkeley. Dept. of Mechanical Engineering.

BOUNDARY INTEGRAL ANALYSIS OF FLOW AND DEFORMATION OF LONG BUBBLES IN CAPILLARIES

M. J. Martinez and K. S. Udell 1987 5 p Presented at the ASME Winter Meeting, Boston, Mass., 13 Dec. 1987
(Contract DE-AC04-76DP-00789)
(DE88-002110; SAND-87-2637C; CONF-871234-4) Avail: NTIS
HC A02

A boundary integral analysis of the creeping motion of a long inviscid bubble in a liquid-filled tube is presented. The effects of interfacial surface tension are included in the stress balance across the liquid-bubble interface. Velocities, stresses and the bubble profile are obtained as a function of the capillary number. Computed values of the thickness of the liquid film between the bubble and tube wall are in excellent agreement with published experimental measurements. The results are of interest in exposing the role of surface tension in multiphase flow in capillary tubes and porous materials.
DOE

N88-17928# Institut za Nuklearne Nauke Boris Kidric, Belgrade (Yugoslavia).

MECHANISTIC MODEL FOR VOID DISTRIBUTION IN FLASHING FLOW

J. Riznic, M. Ishii, and N. Afgan 1987 19 p Presented at the International Center for Heat and Mass Transfer Seminar, Dubrovnik, Yugoslavia, 24 May 1987 Prepared in cooperation with Argonne National Lab., Ill.
(Contract W-31-109-eng-38)
(DE88-002948; CONF-8705224-1) Avail: NTIS HC A03/MF
A01

A problem of discharging of an initially subcooled liquid from a high pressure condition into a low pressure environment is quite important in several industrial systems such as nuclear reactors and chemical reactors. A new model for the flashing process is proposed here based on the wall nucleation theory, bubble growth model and drift-flux bubble transport model. In order to calculate the bubble number density, the bubble number transport equation with a distributed source from the wall nucleation sites is used. The model predictions in terms of the void fraction are compared to Moby Dick and BNL experimental data. It shows that satisfactory agreements could be obtained from the present model without any floating parameter to be adjusted with data. This result indicates that, at least for the experimental conditions considered here, the mechanistic prediction of the flashing phenomenon is possible based on the present wall nucleation based model.
DOE

N88-17929 Stanford Univ., Calif.

A COMPUTATIONAL STUDY OF THRUST AUGMENTING EJECTORS BASED ON A VISCOUS-INVISCID APPROACH Ph.D. Thesis

Thomas Scott Lund 1987 165 p
Avail: Univ. Microfilms Order No. DA8723044

Today's VSTOL designer is in need of an accurate theoretical model that can swiftly evaluate various ejector configurations. A viscous-inviscid interaction technique is advocated as both an efficient and accurate means of predicting the performance of two-dimensional thrust augmenting ejectors. The flowfield is divided into a viscous region that contains the turbulent jet, and an inviscid region that contains the ambient fluid drawn into the device. The inviscid region is computed with a higher order panel method, while an integral method is used for the description of the viscous part. The strong viscous-inviscid interaction present within the injector is simulated in an iterative process where two regions influence each other en route to a converged solution. This formulation retains much of the essential physics of the problem, but at the same time requires only a small amount of computing effort. The model is applied to a variety of parametric and optimization studies involving ejectors having either one or two primary jets. In all cases, it was found that the dual-jet ejector out performs its single jet counterpart. This fact is attributed to enhanced mixing due to an increase in effective ejector length.
Dissert. Abstr.

N88-17930 Cincinnati Univ., Ohio.

IMPLICIT SOLUTION OF THE INCOMPRESSIBLE NAVIER-STOKES EQUATIONS IN PRIMITIVE VARIABLES ON NON-STAGGERED GRIDS Ph.D. Thesis

Mahmoud Lotayee Mansour 1987 136 p
Avail: Univ. Microfilms Order No. DA8722096

An implicit procedure is presented for the solution of the unsteady incompressible Navier-Stokes equations in primitive variables. The unsteady momentum equations are solved implicitly for the velocity field using the approximate factorization technique. The continuity equation is satisfied at each time step through the solution of a Poisson type equation for the static pressure. The

stability analysis indicates that the scheme is unconditionally stable irrespective of the Reynolds number, the time step and the spatial dimensions. Unlike previous solutions, a staggered grid is not required for the pressure equation in order to satisfy the compatibility condition. A consistent finite difference scheme which satisfies the compatibility condition using a nonstaggered grid is used in the finite difference approximation of static pressure Poisson equation. The results of the numerical computations in a driven cavity, which are presented for the history of the residues, at several Reynolds numbers using different computational parameters, demonstrate the excellent convergence characteristics of the solution procedure. Dissert. Abstr.

N88-17931 Illinois Univ. at Urbana-Champaign, Savoy.
A NUMERICAL STUDY OF UNSTEADY TWO-DIMENSIONAL SUBSONIC COMPRESSIBLE BASE FLOW Ph.D. Thesis
David Henry Rudy 1987 255 p
Avail: Univ. Microfilms Order No. DA8721747

In subsonic flow, the wake behind a two dimensional body with a blunt trailing edge is dominated by a regular array of alternately shed vortices. This separated flow produces a low pressure on the base of the body, resulting in a drag component known as the base drag, which can constitute a major portion of the total drag of the body in many cases. One of the devices that was found to reduce the base drag in wind-tunnel experiments is a trailing-edge cavity. However, the flow mechanisms responsible for this drag reduction were not determined from the limited experimental data available. Therefore, the unsteady flow past a slender two-dimensional body with and without a trailing-edge cavity were studied using numerical solutions of the Navier-Stokes equations. The solution procedure utilized an explicit finite-difference scheme with second or fourth order accuracy in a space and second order accuracy in time. A major element in the solution procedure was the selection of an outflow boundary condition which minimized reflection from the boundary back into the solution domain. This solution was verified in computations of subsonic flow past square and circular cylinders, for which excellent agreement was obtained between computed shedding frequencies and experimental data. Solutions for the slender body were obtained. The computed shedding frequency was found to increase with increasing Reynolds numbers. Dissert. Abstr.

N88-17932 Tennessee Univ., Knoxville.
INVESTIGATION OF NON-SYMMETRIC JETS IN CROSS FLOW Ph.D. Thesis
Fan-Ming Yu [1987] 167 p
Avail: Univ. Microfilms Order No. DA8721308

Non-symmetric jets in crossflow were studied with various jet geometries, jet orientations, jet characteristics, and jet to crossflow velocity ratios. Four different cross-section geometry jets were studied and compared with a circular jet with identical jet port cross-sectional area. Standard dye and laser induced fluorescent flow visualization techniques were used to identify the existence of various vortices in the flow field. Among the many forms of secondary vortices produced, three major vortex systems were identified: main jet vortices, wake vortices, and spinoff vortices. A reconstruction of the asymmetric flow field based on observations and its evolution and relationships with established symmetric jets in the crossflow were made. The large scale rolled-up vortex structure which was found at low jet to crossflow velocity ratio is very similar to the hair-pin vortex structure. This observation provides a potential research tool on the study of the structure of turbulent boundary layers. Unsteady jets created by pulsation of the jet flow at low pulsation frequencies give the increase of the depth of penetration. However, the introducing of swirl into jets by passive methods reduces the depth of penetration.
Dissert. Abstr.

N88-17933 Stanford Univ., Calif.
DIGITAL IMAGING TECHNIQUES FOR SINGLE- AND MULTI-PHASE REACTING FLOWFIELDS Ph.D. Thesis
Mark Garrison Allen [1987] 193 p
Avail: Univ. Microfilms Order No. DA8722954

Laser-based imaging techniques for recording the instantaneous two-dimensional distribution of species concentration and droplet size fields in two-phase reacting flowfields were investigated. The techniques are based on right-angle imaging of the elastic and inelastic scattering from planar illumination using tunable, pulsed laser systems. The images are recorded on two-dimensional detector arrays, often with the aid of an image intensifier tube. The species concentration measurements are based on Planar Laser Induced Fluorescence (PLIF). Modeling of the fluorescence process allows conversion of the images into measurements of the instantaneous distribution of the absorbing species in a plane. The technique was demonstrated with hydroxyl, methylidyne, and diatomic carbon radicals in a variety of reacting flowfields, including a heptane-air spray flame. A technique, Planar Multi-photon Photo Dissociation (PMPD), allowing monitoring of the distributions of large molecules by detection of photofragment fluorescence was developed and demonstrated with acetylene. A computer code was constructed to allow integration of the Mie theory for elastic scattering of light by spherical particles over arbitary collection solid angles and arbitary illumination bandwidths. Study of this solution showed that a monotonic function of scattered intensity at 90 degrees versus droplet diameter could be generated using a moderate-bandwidth illumination source. Dissert. Abstr.

N88-17934 Stanford Univ., Calif.
AN EXPERIMENTAL INVESTIGATION OF PRESSURE DRIVEN THREE-DIMENSIONAL TURBULENT BOUNDARY LAYERS Ph.D. Thesis
Shawn David Anderson [1987] 428 p
Avail: Univ. Microfilms Order No. DA8722956

Boundary layer flows are almost always three dimensional in nature, or include regions which are inherently three dimensional. The current work is concerned with gaining a better understanding of the development and behavior of pressure-driven three dimensional turbulent boundary layers. Two boundary layers with different levels of turning were generated in a low speed wind tunnel. The static pressure and mean velocity fields were measured with an X-array hot-wire, and a surface fence probe was used to measure the wall shear stress. The outer parts of the highly skewed mean velocity profiles were reasonably well predicted by the inviscid Squire-Winter theorem. The measured Reynolds stress components were examined in several different coordinate systems using different normalizations. Several derived quantities were computed and compared to previous experimental results. The findings clearly demonstrate the inability of two-dimensional models to correctly predict the Reynolds stress tensor in a skewed boundary layer flow. A comparison ot the predictions of the Rotta T model with the measured data showed that the model was able to adequately predict the streamwise and cross-stream shear stress only when the value of T was adjusted for the particular location. Recommendations for future experiments were drawn from experience gained in the course of this work. The data obtained form a complete set, including boundary and inital conditions, and were archived on magnetic tapes. Dissert. Abstr.

N88-17935 Iowa State Univ. of Science and Technology, Ames.
INTERFEROMETRIC STUDY OF NATURAL CONVECTION HEAT TRANSFER FROM A VERTICAL FLAT PLATE WITH TRANSVERSE ROUGHNESS ELEMENTS Ph.D. Thesis
Sushil Hiroo Bhavnani [1987] 158 p
Avail: Univ. Microfilms Order No. DA8721871

The study of natural convection heat transfer is of significance in several areas of technology. Of particular interest is the dissipation of heat from electronic circuits, where component performance and reliability are strongly dependent on operating temperature. The present research was undertaken to provide information on the nature of heat transfer from rough surfaces. An interferometric technique was used to experimentally measure local heat transfer coefficients. This method is essentially non-intrusive and therfore extremely suitable for the study of low-flux phenomena such as natural convection. Several different types of surfaces were studied-namely, repeated ribbed, stepped, and sinusoidal surfaces. The effects of parameters such as

protuberance height-to-spacing ratios, amplitude of spacing, conductivity of ribs, leading edge geometry, and angle of inclination were studied. It was found that heat transfer enhancement was possible in laminar natural convection using transverse roughness elements with proper sizing and shape selection. The study also showed that roughness elements induced an early transition to turbulent flow. Dissert. Abstr.

N88-17936 Stanford Univ., Calif.
ON SOME ASYMPTOTICS OF LAMINAR FLOW IN A COILED PIPE Ph.D. Thesis
Seo Won Choi [1987] 115 p
Avail: Univ. Microfilms Order No. DA8722979

Several limits of helically coiled pipe flow are examined, using an orthogonal helical coordinate system first introduced by in 1982 for this problem. The fully developed laminar flow in the pipe with a circular cross-section is solved by perturbing the Poiseuille flow. The first limit is the loosely coiled pipe, of which the centerline has a curvature small compared with the radius of the pipe cross section. In the second and third limits, the pitch angle tends to 90 degrees. However, the ratio of the radii is kept constant in the second limit whereas it tends to infinity in the third limit. The relation between the first two asymptotic expansions can be found by relating the small parameters used for the two expansions. The solution for the second limit can be compared to the solution of the flow in a twisted pipe with an elliptic cross section. The solution for the last limit cannot be derived from those for the first two limits and it is much more difficult to find analytically. Dissert. Abstr.

N88-17937 Iowa State Univ. of Science and Technology, Ames.
THE NUMERICAL AND ANALYTICAL STUDY OF BIFURCATION AND MULTICELLULAR FLOW INSTABILITY DUE TO NATURAL CONVECTION BETWEEN NARROW HORIZONTAL ISOTHERMAL CYLINDRICAL ANNULI AT HIGH RAYLEIGH NUMBERS Ph.D. Thesis
Daniel Bartholemew Fant [1987] 262 p
Avail: Univ. Microfilms Order No. DA8721879

Multicellular flow instability due to natural convection between narrow horizontal isothermal cylindrical annuli was investigated numerically and analytically. Bouyancy-induced steady or unsteady flow fields between the annuli are determined using the Boussinesq approximated two-dimensional (2-D) Navier-Stokes (N-S) equations and the viscous dissipated neglected thermal energy equations. The vorticity-stream function formulation of the N-S equations is adopted. Both thermal and hydrodynamic instabilities are explored. An asymptotic expansion theory is applied to the N-S equations in the double-limit of Rayleigh number approaching infinity and gap width approaching zero. Thermal instability of air near the top portions of narrow annuli is considered for various size small gap widths. Numerical solutions of the 2-D N-S equations also yield hysteresis behavior for the two-to-six and two-to four cellular states, with respect to diameter ratios of 1.100 and 1.200. In all cases, finite-differenced solutions to the governing equations are obtained using a stable second-order, fully-implicit time-accurate Gauss-Seidel iterative procedure. Dissert. Abstr.

N88-17938 Stanford Univ., Calif.
INSTABILITY AND TRANSITION IN CURVED CHANNEL FLOW Ph.D. Thesis
Warren Hugh Finlay [1987] 136 p
Avail: Univ. Microfilms Order No. DA8722993

A theoretical and numerical investigation of the streamwise-oriented Dean vortices in a curved channel is presented. With increasing Reynolds number a sequence of bifurcations similar to the bifurcations observed in nonturbulent Taylor-Couette flow between concentric rotating cylinders was found. The transition from laminar curved channel Poiseuille flow to a flow containing axisymmetric Dean vortices was examined using linear and weakly nonlinear analyses. These results are compared to pseudo-spectral simulations based on the incompressible Navier-Stokes equations. With the code, a second transition was found in which the axisymmetric vortices develop a long wavelength streamwise waviness which travels in the streamwise direction. Linear stability analysis of axisymmetric Dean vortex flow to nonaxisymmetric perturbations provides insight into the nature of these instabilities. Further insight is gained from nonlinear numerical solutions. For the channel curvatures studied, angular speeds of the travelling waves are only weakly dependent on Reynolds number and wavenumber. Analysis of the development of these flows from small amplitude disturbances indicates that full development of undulating vortices may require a streamwise distance greater than one circumference, whereas the twisting vortices reach steady state within half this distance at sufficiently large Raynolds numbers. It is suggested that twisting Dean vortex flow is due to shear instability of the axisymmetric Dean vortex flow. Dissert. Abstr.

N88-17939 Virginia Polytechnic Inst. and State Univ., Blacksburg.
TIME-RESOLVED HEAT TRANSFER MEASUREMENTS AND ANALYSIS IN THE WAGE REGION OF A CYLINDER IN CROSSFLOW Ph.D. Thesis
Mahesh Gundappa [1987] 303 p
Avail: Univ. Microfilms Order No. DA8719010

A unique thin film gage was used to measure the fluctuating component of heat transfer from a cylinder placed in a steady crossflow at Reynolds numbers of approximately 19,000 to 30,000. Further, a one-dimensional flow pulsation at 13 Hz was added to the mean flow at a Reynolds number of 19,000, and the case of natural shedding locked-on to exactly one-half the driving frequency was studied. A Gardon gage was also used to measure the time averaged heat transfer under the same conditions. Results showed that the magnitude of the heat transfer fluctuations in the wake were higher than in the attached boundary layer region. The peak to peak fluctuating amplitudes were greater than 50 percent of mean heat flux levels over most of the wake. The phase relationship of the signals was nearly constant in the boundary layer region but varied with angular position in the wake, indicating the existence of different flow regions in the wake. The local time-averaged heat transfer results reflected a 24 percent increase in heat transfer in the wake due to pulsation. Dissert. Abstr.

N88-17940 Iowa Univ., Iowa City.
CENTERPLANE SOURCE DISTRIBUTION FOR SLENDER BODIES Ph.D. Thesis
Pei Pei Hsu [1987] 103 p
Avail: Univ. Microfilms Order No. DA8721405

The irrotational flow of an inviscid, incompressible fluid past a slender body is considered. The zero-Froude-number case for a shiplike form is studied and the body is treated as a double body. A new approach to slender-body theory is used to investigate whether the velocity potential can be represented by a centerplane source distribution. After solving the two-dimensional Neumann slender-body problem at each transverse section, if a line source solutions exist, these two-dimensional source distributions are then interpreted as elements of three-dimensional singularities. Iteration in the exact integral equation for the flow is then used to improve this slender-body solution. An ellipsoid for which the exact centerplane source distribution is known is used to test the validity of the slender-body solution and the effect of the iteration method. The results show very good agreement with the exact solution and the iteration method does improve the accuracy. A slender-body solution at each cross-section for an ogival-parabolic model is found by means of conformal mapping and analytical continuation and compared with a solution for the Modified-Wigley model. A modified iteration formula, suitable for a sharp-edged body is developed and applied. The results of the Modified-Wigley model are compared with the experimental data and the thin-ship calculation for the Wigley model performed by Shahshahan. It shows that both the slender-body solution and the second-order solution are better than the thin-ship solution for Froude numbers less than 0.3 Dissert. Abstr.

N88-17941 Rutgers - The State Univ., New Brunswick, N. J.
PERIODIC NATURAL CONVECTION IN A RECTANGULAR ENCLOSURE OF LOW ASPECT RATIO Ph.D. Thesis
David N. Jones [1987] 205 p
Avail: Univ. Microfilms Order No. DA8723256

Experimental observations using a Wollaston prism interferometer and air as a working fluid, indicated that an unusual periodic flow phenomenon could arise within a differentially heated square cavity for Rayleigh numbers above 5.0E6. Results of experiments conducted to study and further define this phenomenon are presented. Laser Doppler velocimeter studies revealed that for Reynolds numbers up to 3.2E6, the convective flow was circulatory around the cavity interior, with essentially steady and non-periodic velocity. At a Rayleigh number of 3.2E6, the motion abruptly switched to a periodic, oscillatory mode. At a Rayleigh number of 6.25E6, a second mode change in the flow field was noted, resulting in a step increase in frequency. At Rayleigh numbers above 8.75E6, a third mode change occurred resulting in even higher frequencies. The results defined the effect of Rayleigh number on oscillation frequency. Characteristic velocity and temperature profiles are reported for a range of Rayleigh numbers. Schlieren photographs are included in which a periodic plume-like flow is exhibited along the vertical walls. Velocity and temperature versus position correlations are reported along with local temperature to velocity correlations within the fluid boundary layer. It is shown that a series of coherent hot and cold fluid elements are present within the primary flow. The response of these fluid elements to the thermal boundary conditions imposed results in the periodic motion. Dissert. Abstr.

N88-17942 Iowa State Univ. of Science and Technology, Ames.
A THREE-DIMENSIONAL DUAL POTENTIAL PROCEDURE FOR ROTATIONAL FLOWS Ph.D. Thesis
Kuditipudi Venkatram Rao [1987] 161 p
Avail: Univ. Microfilms Order No. DA8721922

A dual potential decomposition of the velocity field into a scalar and a vector potential function is extended to three-dimensions and used in the finite-difference simulation of steady three-dimensional inviscid rotational flow and viscous flow. The finite-difference procedure was used to simulate the flow through the 80 x 120 Foot Wind Tunnel. Rotational flow produced by the stagnation pressure drop across vanes and screens which are located at the entrance of the inlet was modeled using actuator disk theory. Results are presented for two different inlet vane and screen configurations. The numerical predictions are in good agreement with experimental data. The dual potential procedure was also applied to calculate the viscous flow along two- and three-dimensional troughs. Viscous effects are simulated by injecting vorticity which is computed from a boundary-layer algorithm. For attached flow over a three-dimensional trough, the present calculations are in good agreement with other numerical predictions. For separated flow, it is shown from a two-dimensional analysis that the boundary layer approximation provides an accurate measure of the vorticity in regions close to the wall; whereas further away from the wall, caution to be exercised in using the boundary layer equations to supply vorticity to the dual potential formulations. Dissert. Abstr.

N88-17943 New York Univ., New York.
THREE-DIMENSIONAL INCOMPRESSIBLE FLOWFIELD ANALYSIS FOR ESTABLISHING ROTOR DESIGNS WHICH OPTIMIZE POWER EXTRACTION Ph.D. Thesis
Yu Shen [1987] 188 p
Avail: Univ. Microfilms Order No. DA8722788

The full Navier-Stokes equations in the primitive variable form were applied to the flowfield produced by a rotor. The rotor is modeled as an actuator disk, the flow is taken as axisymmetric, and the turbulence transport processes are described by an integrated, turbulence-kinetic-energy equation. The analysis applies physical conditions to the discontinuity of pressure and swirl velocity at the point where the disk is located. The Semi-implicit method for pressure-linked equation (SIMPLE) and alternating difference implicit (ADI) numerical procedures are selected to solve the Navier-Stokes equations. The solution of the numerical procedures converges very fast, and show that the method is capable of good predictions of physical reality, and affords a tool for practical application. The Glauert two-dimensional rotor design theory is extended by developing a three-dimensional model. An improved mathematical formula for calculating chord and twist angle distributions of the rotor blade was formed. The three-dimensional model coupled with the results of the numerical method will allow the rotor designs to establish optimize power extraction. Finally, the numerical procedures and the three-dimensional model for kinetic hydro energy conversion system (KHECS) is applied to optimize the power extraction from the rotor blade designs. Dissert. Abstr.

N88-17944 Iowa Univ., Iowa City.
FREE-SURFACE FLOW PHENOMENA AHEAD OF A TWO-DIMENSIONAL BODY IN A VISCOUS FLUID Ph.D. Thesis
Chii-Jau Tang [1987] 230 p
Avail: Univ. Microfilms Order No. DA8721454

The zero tangential-stress condition generates vorticity at a curved free-surface, viscosity diffuses the vorticity into the fluid to form a boundary layer, and convective transport downstream leads to a thickening of the boundary layer. It is believed that this free-surface boundary layer is responsible for the origin of the vortices which were observed ahead of a body in motion. The flow near a free-surface is first analyzed to examine the occurrence of a stagnation point which, in turn, explains the origin of the bow vortices. The free-surface boundary layer equations are then derived from an order of magnitude analysis and an integral method for their solution is presented. The potential flow ahead of several bodies is calculated and the resulting free-surface shapes and velocity fields are used to estimate the momentum thickness of the boundary layer. A numerical method for the solution of the full, unsteady, two-dimensional Navier-Stokes equations with the exact boundary conditions at the free-surface is then presented. Special treatments for the application of the exact boundary conditions at the free-surface are discussed. The numerical method is first tested on two solitary-wave problems and the results are compared with available solutions and some experimental data. The method is then applied to calculate the unsteady free-surface flow ahead of a long two-dimensional, surface-piercing body. Dissert. Abstr.

N88-17945# Pacific Northwest Labs., Richland, Wash.
MICROCOMPUTER ANALYSIS OF REGENERATIVE HEAT EXCHANGERS FOR OSCILLATING FLOW
R. A. Hutchinson and S. E. Lyke Mar. 1987 9 p Presented at the ASME/JSME/ISES Solar Energy Conference, Honolulu, Hawaii, 22 Mar. 1987
(Contract DE-AC06-76RL-01830)
(DE88-001773; PNL-SA-14137; CONF-870307-25) Avail: NTIS HC A02/MF A01

Regenerative heat exchangers for use in oscillating flows such as those occurring in Stirling engines present considerable analytical problems to the thermal engineer. A simplified finite element analysis has been implemented in a spreadsheet, providing improved access to analytical assumptions and allowing parametric analysis of current heat transfer data. In addition, an irreversibility analysis has been implemented using the thermal and friction results in the spreadsheet. It is suited for evaluation and insights into loss tradeoffs inside operating regenerators, to suggest new regenerator design concepts, and to focus experimental work. DOE

N88-17946# Argonne National Lab., Ill.
A REVIEW OF FLOW-INDUCED VIBRATION IN TWO-PHASE FLOW
S. S. Chen 1987 5 p Presented at the ASME Winter Meeting, Boston, Mass., 13 Dec. 1987
(Contract W-31-109-eng-38)
(DE88-002873; CONF-871234-2) Avail: NTIS HC A02

Based on the homogeneous two-phase flow model and theory of elasticity, the dynamic fluid/structure interaction can be

described by the same equation as that for single phase flow. Based on the direction of flow with respect to the major axis of structural components, two-phase flow-induced vibration problems can be divided into two groups: axial flow in which the flow direction is parallel to the structural axis and crossflow in which the flow direction is perpendicular to the structural axis. Both axial-flow and crossflow-induced vibrations have been studied in past decades. In this note, a review of two-phase flow-induced vibrations is presented for crossflow as well as axial flow. The objectives are to summarize the excitation mechanisms, mathematical models, response characteristics, design considerations and future research needs. DOE

N88-17947# Argonne National Lab., Ill.
ONE-DIMENSIONAL LEAKAGE-FLOW VIBRATION INSTABILITIES
T. M. Mulcahy 1987 58 p Presented at the International Symposium on Flow-induced Vibration and Noise, Chicago, Ill., 28 Nov. 1987
(Contract W-31-109-eng-38)
(DE88-002875; CONF-871196-1) Avail: NTIS HC A04/MF A01

Simple boundary conditions, pressure losses, and channel geometries necessary for the unstable, rigid-body translational vibrations of the wall of a one-dimensional leakage flow channel are identified. General expressions for the flow damping and stiffness forces acting on the vibrating channel wall are derived and specific results are given for channels with wall friction, point pressure losses, sharp-edged constrictions, and diverging or converging widths. The minimum conditions necessary for dynamic and static (divergence) instability were found to be an upstream point pressure loss and a diverging channel width with a finite length throat region, respectively. DOE

N88-17948# Integral Technologies, Inc., Westmont, Ill.
MULTIDIMENSIONAL MODELING OF CONVECTIVE HEAT TRANSFER WITH APPLICATION TO IC ENGINES Progress Report
M. J. Jennings and T. Morel 11 Dec. 1987 14 p
(Contract DE-AC04-86AL-33183)
(DE88-003398; DOE/AL-33183/T5) Avail: NTIS HC A03/MF A01

The objective of this project is to develop a more comprehensive understanding of the convective heat transfer process in complex, unsteady turbulent reacting flows, typical of those which occur in internal combustion engines. The specific area of research is the representation of heat transfer in detailed multi-dimensional Navier-Stokes models, and modeling of turbulent transport mechanisms. The detailed tasks include a review of relevant prior work. Based on this review, and original work done under this contract, several modeling approaches are being formulated and will be further studied and tested. The tests will be carried out on flow cases which have relevance to engine flows, and for which reliable experimental data exist. This report discusses the results of current work and describes experiments to be performed. DOE

N88-17949# Mechanical Technology, Inc., Latham, N. Y.
FREE-PISTON STIRLING ENGINE DIAPHRAGM-COUPLED HEAT-ACTUATED HEAT PUMP COMPONENT TECHNOLOGY PROGRAM, PHASE 1C Final Report
R. A. Ackermann Jul. 1987 151 p
(Contract DE-AC05-84OR-21400)
(DE88-003654; ORNL/Sub-86-47985/1) Avail: NTIS HC A08/MF A01

During Phase 1 of the Heat-Actuated Heat Pump Development Program, a Breadboard Heat Pump power module consisting of a free-piston Stirling engine (FPSE), a hydraulic transmission, and a linear-resonant refrigerant compressor was designed and fabricated. The essential ground rule of this development was the use of an existing Mechanical Technology Incorporated FPSE. During testing, this breadboard heat pump fell far short of its design capacity of 3.0 tons of cooling at 95°F ambient conditions. In Phases 1A and 1B, excessive losses in the hydraulic transmission were identified as the cause of the shortfall in capacity and the hydraulically driven counterweight inside the transmission as the major cause of the high loss. The object of Phase IC of the program was to replace the internal counterweight with an external vibration absorber and to test the breadboard heat pump, shown over a broad range of ambient conditions from 0 to 95 F. The work elements of the Phase 1C program addressed the design, fabrication, and test of the external absorber, the development of a comprehensive test plan for the breadboard heat pump, and the steady-state testing of the heat pump to determine its performance in both the heating and cooling modes. The specific objectives of the testing were, first, to operate the heat pump over a range of ambient conditions from 0 to 95 F; second, to establish the steady-state performance of the unit at each of these points; and third, to achieve a minimum cooling capacity of 2.5 tons at the 95 F ambient conditions. The results are discussed in this report. DOE

N88-17950# Maryland Univ., College Park. Dept. of Mechanical Engineering.
TRANSIENT COOLING OF A HOT SURFACE BY DROPLETS EVAPORATION, MARCH 1986 - MARCH 1987 Final Report
M. diMarzo, Z. Y. Wang, and W. H. Meng Nov. 1987 78 p
Sponsored by National Bureau of Standards, Gaithersburg, Md.
(PB88-153341; Rept-87-11; NBSIR/GCR-87/534) Avail: NTIS HC A05/MF A01 CSCL 20D

The study of droplet evaporation on a high thermal conductivity semi-infinite solid is investigated as well as the solid thermal behavior both theoretically and experimentally. The behavior of a low thermal conductivity solid is the objective of experimental studies. A coupled analytical model for the solid and the evaporating liquid is being derived to predict the cooling effect induced by the evaporating droplet. GRA

N88-17951# Technische Hogeschool, Delft (Netherlands). Afd. der Elektrotechniek.
BOUNDARY-INTEGRAL-EQUATION METHOD FOR COMPUTING THE THREE-DIMENSIONAL FLOW OF GROUNDWATER
R. M. vanderWeiden and A. T. deHoop Apr. 1987 12 p
(PB88-126891; Rept-1987-07) Avail: NTIS HC A03/MF A01 CSCL 20D

The boundary integral equation method for computing the three dimensional steady flow of groundwater is described. Starting from the basic flow equations, a reciprocity theorem is derived, from which source type integral representations for the flow field quantities are obtained. Utilizing there representations, the relevant boundary integral equations are arrived at. Their numerical handling is discussed in some detail. Author

N88-17952# Science Applications International Corp., La Jolla, Calif.
FULLY LAGRANGIAN RENORMALIZED APPROXIMATION THEORY OF FLUID TURBULENCE Progress Report
E. A. Frieman and W. K. Hagan 1988 16 p
(Contract DE-AC03-84ER-13174)
(DE88-004960; DOE/ER-13174/T8) Avail: NTIS HC A03/MF A01

The purpose of this paper is to discuss our refinement and extension of the work of Y. Kaneda on a Lagrangian Renormalized Approximation (LRA) for homogeneous hydrodynamic turbulence. Kaneda's results are important to the development of a consistent theory of turbulence because the LRA theory successfully overcomes the failure of other turbulence theories (namely the Direct Interaction Approximation) to predict the Kolmogorov wavenumber spectrum. It is thought that this success is due to the use of a Lagrangian rather than Eulerian description of the fluid so that convection of the small eddies by the large ones is properly treated. However, some aspects of these results are puzzling and are considered here. For example, the form of the correlation function and the value of the Kolmogorov constant, K, depend on the choice of the form of the correlation function. DOE

N88-17953# Los Alamos National Lab., N. Mex.
NF85: A THREE-DIMENSIONAL, AIR-DYNAMICS COMPUTER CODE FOR ANALYZING EXPLOSIONS IN STRUCTURES
R. G. Steinke Dec. 1987 137 p
(Contract W-7405-eng-36)
(DE88-005085; LA-11158-M) Avail: NTIS HC A07/MF A01

The NF85 (Near-Field 85) computer program analyzes the effect of explosions on the dynamic behavior of air in structures. The explosion is modeled as a time- and spallese-dependent source of equivalent air mass and energy. Chemical reactions can be modeled directly with a combustion-model option, and tracer particles may be used to monitor combustion-products convection by the air. The near-field region of the explosion is modeled in three-dimensional Cartesian or cylindrical geometry. Internal structures can be defined in the region to reflect shock waves and obstruct airflow. A convenient dump/restart capability allows the movement or removal of internal structures during the transient solution. The effects of the surrounding far-field region are modeled at the three-dimensional region's external boundary by a wall surface, time- and space-dependent pressure or velocity boundary conditions, and/or one-dimensional Cartesian-geometry regions attached to openings in the external boundary. Ventilation ducts, passageways, and adjacent rooms can be modeled directly with one-dimensional regions, and the presence of blowers and filters can be modeled as well. DOE

N88-17954*# Case Western Reserve Univ., Cleveland, Ohio. Dept. of Mechanical and Aerospace Engineering.
THE USE OF MULTIGRID TECHNIQUES IN THE SOLUTION OF THE ELROD ALGORITHM FOR A DYNAMICALLY LOADED JOURNAL BEARING M.S. Thesis. Final Report
Claudia M. Woods Feb. 1988 33 p
(Contract NCC3-30)
(NASA-CR-180873; E-3897; NAS 1.26:180873) Avail: NTIS HC A03/MF A01 CSCL 20D

A numerical solution to a theoretical model of vapor cavitation in a dynamically loaded journal bearing is developed, utilizing a multigrid iterative technique. The code is compared with a presently existing direct solution in terms of computational time and accuracy. The model is based on the Elrod algorithm, a control volume approach to the Reynolds equation which mimics the Jakobssen-Floberg and Olsson cavitation theory. Besides accounting for a moving cavitation boundary and conservation of mass at the boundary, it also conserves mass within the cavitated region via liquid striations. The mixed nature of the equations (elliptic in the full film zone and nonelliptic in the cavitated zone) coupled with the dynamic aspects of the problem create interesting difficulties for the present solution approach. Emphasis is placed on the methods found to eliminate solution instabilities. Excellent results are obtained for both accuracy and reduction of computational time. Author

N88-17955*# National Aeronautics and Space Administration. Langley Research Center, Hampton, Va.
ON THE INTERACTION OF TOLLMEIN-SCHLICHTING WAVES IN AXISYMMETRIC SUPERSONIC FLOWS Final Report
P. W. Duck and P. Hall (Exeter Univ., England) Jan. 1988 21 p Submitted for publication
(Contract NAS1-18107)
(NASA-CR-181619; ICASE-88-10; NAS 1.26:181619) Avail: NTIS HC A03/MF A01 CSCL 20D

Two-dimensional lower branch Tollmein-Schlichting waves described by triple-deck theory are always stable for planar supersonic flows. The possible occurrence of axisymmetric unstable modes in the supersonic flow around an axisymmetric body is investigated. In particular flows around bodies with typical radii comparable with the thickness of the upper deck are considered. It is shown that such unstable modes exist below a critical nondimensional radius of the body a sub 0. At values of the radius above a sub 0 all the modes are stable while if unstable modes exist they are found to occur in pairs. The interaction of these modes in the nonlinear regime is investigated using a weakly nonlinear approach and it is found that, dependent on the frequencies of the imposed Tollmein-Schlichting waves, either of the modes can be set up. Author

N88-17956# Battelle Columbus Labs., Research Triangle Park, N.C.
DROPLET FORMATION FOR LIQUID MONOPROPELLANT JETS Technical Report, 17 Mar. 1986 - 15 Feb. 1987
Nelson A. Macken 11 Feb. 1987 64 p
(Contract DAAG29-81-D-0100)
(AD-A187172; BRL-TR-2848) Avail: NTIS HC A04/MF A01 CSCL 19A

The hydrodynamic development of droplets for conditions approximating those in the combustion chamber of regenerative liquid propellant guns has been investigated. The report contains a literature survey and discussion of various breakup mechanisms. Aerodynamic interaction is analyzed using classical stability theory and a formulation applied to anticipated working conditions. The model predicts mass removed and droplet size as a function of time. Results indicate that the jet does break up with almost all liquid atomized. Comparison to a simple burning rate model verifies that the hydrodynamic model is primarily responsible for liquid removal from the intact core. Results conflict with recent inverse gun code predictions which suggest significant liquid accumulation is occurring; i.e., the jet does not fully atomize and subsequently burn. A discussion of possible reasons for this discrepancy is included. GRA

N88-17957# Pennsylvania State Univ., University Park. Dept. of Mechanical Engineering.
EXPERIMENTAL RESEARCH ON SWEPT SHOCK WAVE/BOUNDARY LAYER INTERACTIONS Interim Technical Report, 1 Apr. 1986 - 31 Mar. 1987
Gary S. Settles Jun. 1987 29 p
(Grant AF AFOSR-0082-86)
(AD-A187250; PSU/ME-R-86/87-0034; AFOSR-87-1453TR)
Avail: NTIS HC A03/MF A01 CSCL 20D

Experiments were carried out to assess Mach number effects on boundary layer due to generic fin and swept compression corner geometries. An extensive set of fin interaction experiments was carried out at constant Reynolds number over the Mach number range of 2.5 to 4.0. Data thus far consist of surface flow visualization photographs and laser light-screen visualizations of flowfield structure. Additional experiments were conducted to assess the possibility that experimental data of this type might depend on the wind tunnel facility in which the experiments were performed. That was not found to be the case. Results of the parametric Mach number study revealed that Mach number effects over the range considered are essentially inviscid. These were accounted for simply by referencing measured quantities to the freestream Mach angle. The interaction growth with increasing shock strength was found to be nonlinear, contrary to previous results. Initial results from swept compression corner experiments are also reported. GRA

N88-17958# Lehigh Univ., Bethlehem, Pa. Dept. of Mechanical Engineering and Mechanics.
AN ANALYSIS OF THE MOTION AND EFFECTS OF HAIRPIN VORTICES Interim Report, Jul. 1985 - Jul. 1987
Thon-Lon Hon and James D. Walker Jun. 1987 223 p
(Contract F49620-85-C-0108)
(AD-A187261; FM-11; AFOSR-87-1389TR) Avail: NTIS HC A10/MF A01 CSCL 20D

Recent studies suggest that the hairpin vortex plays an important, possibly dominant, role in the dynamics of turbulent flows near walls. This study addresses the following topics of the motion of hairpin vortices near solid walls on a theoretical basis: the nature of the evolution of hairpin vortices in a shear flow; the type of flow induced near a wall by a convected hairpin vortex; the character of the viscous response near a wall to the hairpin vortex motion; and the nature of the interaction of 2 hairpin vortices. A numerical procedure is developed to allow accurate evaluation of the trajectory of a 3-dimensional vortex for vortices having small cores. The integration method is based on a numerical

approximation to the Biot-Savart integral; most existing vortex calculation methods have severe stability problems for vortices with small cores. These problems are overcome with the present method and technique is applied to compute the evolution of convected vortex loops and hairpin vortices, both in uniform flow and in shear flow above a wall. For hairpin vortices evolving in a shear flow, a regenerative process is observed wherein secondary hairpin vortices form outboard of the original hairpin vortex in a manner consistent with experimental observations. Calculations for 2 hairpin vortices, initially close to one another in a shear flow, show that the vortices interact to reinforce one another. Author

N88-17959# Von Karman Inst. for Fluid Dynamics, Rhode-Saint-Genese (Belgium).
VELOCITY MEASUREMENTS IN A 3D (THREE DIMENSIONAL) SHOCK WAVE LAMINAR BOUNDARY LAYER INTERACTION Final Report, 1 Aug. 1985 - 31 Jul. 1986
G. Degrez and J. J. Ginoux 31 Jul. 1987 46 p
(Grant AF AFOSR-0273-83)
(AD-A187334; VKI-CR8734AR; AFOSR-87-1388TR) Avail: NTIS HC A03/MF A01 CSCL 20D

An experimental investigation of the three dimensional laminar boundary layer separation associated with an incident swept shock wave was conducted in the von Karman Institute (VKI) S-1 supersonic wind tunnel operating at Mach 2.15. Mean velocity profiles were measured both in the attached separated and reattachment flow regions using a laser Doppler velocimeter. A comparison of the measurements with a full 3D Navier-Stokes solver, developed at the VKI, exhibited good agreement in all three regions, thus validating the code which was based on the Beam-Warming algorithm. The report also reviews the earlier parts of the grant dealing with the necessary developments in LDV to achieve high quality data, and the of the 2D shock boundary layer interaction. GRA

N88-17960# Michigan Univ., Ann Arbor. Dept. of Aerospace Engineering.
TURBULENCE INTERACTIONS IN SINGLE- AND MULTI-PHASE TURBULENT MIXING AND COMBUSTION PROCESSES Final Report, 1 Aug. 1986 - 31 Jul. 1987
G. M. Faeth and R. N. Parthasarathy 15 Aug. 1987 29 p
(Grant AF AFOSR-0248-86)
(AD-A187505; AFOSR-87-1475TR) Avail: NTIS HC A03/MF A01 CSCL 20D

Turbulent multiphase flows (particle-laden jets, particle-laden flows in ducts, sprays, etc.) have technical applications for the combustion processes of airbreathing propulsion systems, and solid and liquid rocket motors. This report describes an upgrade of a single channel laser Doppler anemometer (LDA) to provide critical measurements needed to gain a better understanding of this class of multiphase flows. The upgrade yields a system which can be configured in several ways: a phase-discriminating LDA which provides either two phase-velocity components at a single point, or phase velocities at two points which are independently transversable; and a phase-Doppler LDA which can provide two-component particle (or drop) size and velocity information at a single point. All systems can yield particle (or drop) number fluxes. The arrangement of these systems is described along with some representative results using the phase-discrimination configuration. GRA

N88-17961# Princeton Univ., N. J. Gas Dynamics Lab.
THE STRUCTURE AND CONTROL OF THREE-DIMENSIONAL SHOCK WAVE TURBULENT BOUNDARY LAYER INTERACTIONS Annual Report, 15 Jul. 1986 - 14 Jul. 1987
Seymour M. Bogdonoff 24 Nov. 1987 20 p
(Contract F49620-86-C-0094)
(AD-A187642; AFOSR-87-1932TR) Avail: NTIS HC A03/MF A01 CSCL 20D

A review of the work completed during the first year of research on the subject contract is presented. Papers and publications generated, staff, and students involved in research are noted, along with a brief description of the on-going program. Significant results have been obtained in defining the structure of the three-dimensional shock wave turbulent boundary layer interaction by combining detailed experiments with coordinated major computational programs. GRA

N88-17962# Oxford Univ. (England). Dept. of Engineering Science.
WAKE INTERACTION EFFECTS ON THE TRANSITION PROCESS ON TURBINE BLADES Report, 1 Sep. 1986 - 31 Aug. 1987
R. W. Ainsworth and J. E. LaGraff 30 Oct. 1987 33 p Prepared in cooperation with Syracuse Univ., N.Y.
(Grant AF AFOSR-0295-85)
(AD-A188020; AFOSR-87-1919TR; SR-2) Avail: NTIS HC A03/MF A01 CSCL 20D

The characterization of the nozzle guide vane inlet and exit conditions in the Oxford University Isentropic Light Piston Tunnel fully 3-D annular rotating stage has been undertaken. Measurements included hot wire anemometry and pressure/Mach number distributions. Preparations for the rotor heat transfer instrumentation/data acquisition hardware and software are also in progress. Further development of a numerical model to predict the effects of wake passing and transition is reported. The convection of the wake through the passage is predicted, allowing for estimations of the expected times for which the boundary layer is disturbed by the wake fluid. The new model for the random generation and subsequent growth and convection of the turbulent spots produces a time-resolved prediction of the intermittent heat transfer signals by use of a time-marching procedure. By superimposing the two numerical models it is possible to simulate the measured instantaneous heat transfer characteristics and to estimate the effective average intermittency along the blade surface and compare the results to the measured intermittency values. GRA

N88-17963# National Aerospace Lab., Tokyo (Japan).
FLOW PATTERNS INDUCED BY VORTICES
Hideaki Nishimura May 1987 22 p In JAPANESE; ENGLISH summary
(NAL-TR-932; ISSN-0389-4010) Avail: NTIS HC A03/MF A01

When located in a confined area, vortices form a flow field in the region of mutual interference. The obtained flow field is very useful in the analysis of the secondary flow in a cascade. In this report three flow patterns are calculated by using the elliptic and hyperbolic functions. The flows appear in the following: (1) a parallelogram bounded by four boundaries; (2) a channel restricted by upper and lower boundaries; and (3) a half region confined by upper, lower and left boundaries. The method of vortex distribution in a calculation plane and the calculated results are also shown. A few comments on the characteristics of the elliptic functions are presented in the appendix. It is concluded that this method is effective in analyzing the secondary flows with vortices in a cascade. Author

N88-17821# Boelkow-Entwicklingen K.G., Stuttgart (West Germany). Entwicklungsabteilung Mathematik.
BOUNDARY LAYER CALCULATION USING DIGITAL COMPUTERS [GRENZSCHICHTBERECHNUNG MIT DIGITALEN RECHENAUTOMATEN]
Richard Eppler *In* MBB GmbH, Research and Development. Technical-Scientific Publications (1956-1987): Retrospective View and Prospects. Jubilee Edition on the Occasion of the 75th Anniversary of Dipl.-Engr. Dr.-Engr. E.H. Ludwig Boelkow 1987 p 25-32 In GERMAN (For primary document see N88-17819 10-31)
(Rept-MM-4) Copyright Avail: NTIS HC A14/MF A01

N88-17846# Messerschmitt-Boelkow-Blohm G.m.b.H., Ottobrunn (West Germany). Helicopter and Military Aircraft Group.
ZONAL SOLUTIONS FOR VISCOUS FLOW PROBLEMS. FINITE APPROXIMATIONS IN FLUID MECHANICS
Ernst H. Hirschel and Manfred A. Schmatz *In its* Research and Development. Technical-Scientific Publications (1956-1987):

Retrospective View and Prospects. Jubilee Edition on the Occasion of the 75th Anniversary of Dipl.-Engr. Dr.-Engr. E.H. Ludwig Boelkow 1987 p 173-178 Repr. from Notes on Numerical Fluid Mechanics (Brunswick/Wiesbaden, Fed. Republic of Germany), v. 14, 1986 (For primary document see N88-17819 10-31)
(MBB/LKE-122/S/PUB/226) Copyright Avail: NTIS HC A14/MF A01

35 INSTRUMENTATION AND PHOTOGRAPHY

Includes remote sensors; measuring instruments and gages; detectors; cameras and photographic supplies; and holography.

For aerial photography see *43 Earth Resources and Remote Sensing.* For related information see also *06 Aircraft Instrumentation,* and *19 Spacecraft Instrumentation.*

N88-17964*# Ithaco, Inc., Ithaca, N.Y.
ISTP SBIR PHASE 1 FULL-SKY SCANNER: A FEASIBILITY STUDY Final Report
6 Aug. 1986 60 p
(Contract NAS5-29276)
(NASA-CR-180749; NAS 1.26:180749; Rept-93226) Avail: NTIS HC A04/MF A01 CSCL 14B

The objective was to develop a Full-Sky Sensor (FSS) to detect the Earth, Sun and Moon from a spinning spacecraft. The concept adopted has infinitely variable resolution. A high-speed search mode is implemented on the spacecraft. The advantages are: (1) a single sensor determines attitude parameters from Earth, Sun and Moon, thus eliminating instrument mounting errors; (2) the bias between the actual spacecraft spin axis and the intended spin axis can be determined; (3) cost is minimized; and (4) ground processing is straightforward. The FSS is a modification of an existing flight-proven sensor. Modifications to the electronics are necessary to accommodate the amplitude range and signal width range of the celestial bodies to be detected. Potential applications include ISTP missions, Multi-Spacecraft Satellite Program (MSSP), dual-spin spacecraft at any altitude, spinning spacecraft at any altitude, and orbit parameter determination for low-Earth orbits.
J.P.B.

N88-17965 Stanford Univ., Calif.
AN INTEGRATED PRESSURE SENSOR FOR IN-VIVO USE Ph.D. Thesis
Brent Emil Burns [1987] 191 p
Avail: Univ. Microfilms Order No. DA8722969

Biomedical pressure sensors for in-vivo use must provide a stable and accurate pressure signal for periods of up to one year. Long-term survival and accuracy requires a device with on-chip signal conditioning circuitry to produce a robust output signal. Signal conditioning options are, in decreasing order of robustness, time-domain outputs (pulse code modulation (PCM), frequency modulation (FM), pulse time modulation (PTM)) followed by the analog outputs (amplitude modulation, pulse amplitude modulation, buffered baseband, and the direct output from the transducer). In descending order of cost, the options are PCM, PAM, AM, PTM, FM, buffered baseband, and basic sensor. A sensor with a predicted 0.6 microampere/torr baseband output was designed. Fabricating the sensor package with on-chip circuitry led to several challenging hurdles. The technologies developed for the fabrication process combining the bipolar process with the sensor-structure process, including a robust lead attachment scheme, should prove useful in the development of other type sensors for measuring pressure and other variables such as acceleration, temperature, force, humidity, and pH. Dissert. Abstr.

N88-17966# Sandia National Labs., Albuquerque, N. Mex.
A TECHNIQUE FOR LOW LEVEL, WIDE RANGE CW MICROWAVE POWER METER CALIBRATIONS
R. J. Haushalter Oct. 1987 25 p
(Contract DE-AC04-76DP-00789)
(DE88-004147; SAND-87-1851) Avail: NTIS HC A03/MF A01

An improved technique facilitating the calibration of CW microwave power meters at extremely low power levels and over wide ranges is presented. A 3-directional-coupler assembly is at its heart. A computer-controlled, semi-automated system that collects, stores and processes raw calibration documentation as a final product is introduced. DOE

N88-17967# National Bureau of Standards, Gaithersburg, Md. Temperature and Pressure Div.
NBS (NATIONAL BUREAU OF STANDARDS) MEASUREMENT SERVICES: PLATINUM RESISTANCE THERMOMETER CALIBRATIONS
B. W. Mangum Oct. 1987 369 p
(PB88-138367; NBS/SP-250/22; LC-87-619875) Avail: NTIS HC A16/MF A01 CSCL 14B

The document describes in detail the instruments and the measurement methods used in the realization and transfer of the International Practical Temperature Scale of 1968, Amended Edition of 1975 (IPTS-68(75)), as maintained at the NBS in the region from 13.81 K to 903.89 K. This is the region in which the platinum resistance thermometer, meeting certain specifications, is the standard instrument for interpolating between the defining fixed points of the scale at which it is calibrated. An analysis of the sources of error encountered in calibration, and estimates of uncertainty and its propagation, are presented. GRA

N88-17968# Sandia National Labs., Albuquerque, N. Mex.
STRATEGIC PLACEMENT OF ACCELEROMETERS TO MEASURE FORCES BY THE SUM OF WEIGHTED ACCELERATIONS
T. G. Priddy, D. L. Gregory, and R. G. Coleman 1987 28 p Presented at the 6th International Modal Analysis Conference, Orlando, Fla., 1 Feb. 1988
(Contract DE-AC04-76DP-00789)
(DE88-002262; SAND-87-2567C; CONF-880220-4) Avail: NTIS HC A03/MF A01

A force identification method using a sum of weighted accelerations (SWA) has recently been demonstrated. Accuracy of the SWA method depends on the number and the placement of the accelerometers and the selection of the best set of weighting factors. Procedures have been proposed for determining the number of accelerometers required for a given frequency bandwidth and an experimental-analytical method has been derived to calculate the optimum set of weighting coefficients. A procedural method is described and demonstrated in this paper for determining the placement of gages using results from a free-body modal characterization. Our proposed procedure is to place accelerometers at the nodes of the highest free-body vibrational mode in the frequency bandwidth of interest. All modes below this mode are well represented in the acceleration measurements. The weighting factors can be determined by the previously reported methods or according to a theoretical method introduced in this paper. The present method satisfies the objective of zeroing-out the contribution of free-body vibration modes in the SWA method of force identification. We illustrate the theory through the analysis of a simple beam, and we then demonstrate the procedure with the laboratory testing of a softly suspended aluminum beam.
DOE

N88-17969# Brookhaven National Lab., Upton, N. Y.
CAPACITIVE CHARGE DIVISION IN CENTROID FINDING CATHODE READOUTS IN MWPCs
G. C. Smith, J. Fischer, and V. Radeka 1987 5 p Presented at the Nuclear Science Symposium, San Francisco, Calif., 21 Oct. 1987
(Contract DE-AC02-76CH-00016)
(DE88-003545; BNL-40486; CONF-871006-21) Avail: NTIS HC A02/MF A01

A technique is described in which the centroid of induced charge on cathode strips in a proportional chamber can be determined with reduced differential and integral nonlinearity, without increasing

the number of readout channels. It is based on capacitive charge division from intermediate cathode strips to adjacent readout strips, and may be applied to a variety of position readout principles.
DOE

N88-17970# Lawrence Livermore National Lab., Calif.
PERFORMANCE OF A PHOTON COUNTING MICROCHANNEL PLATE INTENSIFIER WITH WEDGE AND STRIP IMAGE READOUT
O. H. W. Siegmund, C. J. Hailey, J. H. Lupton, and R. E. Stewart 26 Aug. 1987 18 p Presented at the 9th Symposium on Photoelectronic Imaging Devices, London, United Kingdom, 7 Sep. 1987 Prepared in cooperation with California Univ., Berkeley and KMS Fusion, Inc., Ann Arbor, Mich.
(Contract W-7405-eng-48)
(DE88-003831; UCRL-96412; CONF-8709139-2) Avail: NTIS HC A03/MF A01

We have developed a 40mm aperture sealed tube imaging detector for photon counting applications in astronomy and atomic physics. The device has a fiber optic input window with a semitransparent bialkali photocathode deposited on its inner surface. The photocathode is proximity focussed to a stack of three microchannel plates (MCP's), each having an 80:1 channel length to diameter ratio, placed in a back to back (Z) configuration. The signal levels on the wedge and strip electrodes of the readout anode, behind the MCP stack, are linearly proportional to single photon event X and Y positions. The event positions are deduced by direct digitization of the individual wedge, strip and zig-zag amplified signals, followed by calculation of the X and Y positions in software.
DOE

N88-17971# California Univ., Berkeley. Lawrence Berkeley Lab.
THE USE OF OPTICAL FIBERS FOR SHOCK PRESSURE AND TIMING MEASUREMENTS AT HIGH PRESSURES
M. J. George, R. Menikoff, and L. R. Veeser Jan. 1988 34 p
(Contract W-7405-eng-36)
(DE88-004012; LA-11148-MS) Avail: NTIS HC A03/MF A01

We have investigated the use of quartz fibers as arrival-time detectors and as absolute pressure transducers for shock waves at pressures of 50 GPa and higher. Four experiments were fired in which a steel flyer plate impacted an instrumented steel target plate. Arrival times measured with the fibers are compared with those given by more conventional electrical pin switches. Additional signal features are related to hydrodynamic events and compared with calculations. Calibrated signal voltages are related to shock temperatures through blackbody radiation theory. The temperatures are then related to pressures using shock Hugoniot data, and the results compare favorably with those of the hydrodynamic calculations.
DOE

N88-17972# Princeton Univ., N. J. Dept. of Chemical Engineering.
APPARATUS FOR THE STUDY OF SILICON FILM DEPOSITION AND SILICON ETCHING Final Report, 1 Aug. 1986 - 31 Jul. 1987
Jay Benziger 31 Jul. 1987 4 p
(Grant AF AFOSR-0217-86)
(AD-A187616; AFOSR-87-1588TR) Avail: NTIS HC A02/MF A01 CSCL 14B

A special vacuum system used to study the surface reactions in thin film deposition and etching was equipped with surface analytical techniques and ion sputtering for preparing and characterizing surfaces. X-ray and ultraviolet photoelectron spectroscopy systems were obtained from Vacuum Science Workshop and installed in a 2-chamber vacuum system along with an ion sputtering gun for sample cleaning. These techniques will be used in conjunction with infrared ellipsometry and modulated molecular beam techniques to elucidate the kinetics and mechanisms of surface reactions of silicon deposition and etching.
GRA

N88-17973# Materials Research Labs., Ascot Vale (Australia).
TRACE ANALYSIS BY MS/MS ON A DOUBLE FOCUSSING MASS SPECTROMETER
V. T. Borrett and A. G. Moritz May 1987 14 p
(AD-A187954; MRL-R-1064; DODA-AR-005-145) Avail: NTIS HC A03/MF A01 CSCL 14B

Recent advances in mass spectrometry - mass spectrometry (ms/ms) indicate that this techniques has a number of advantages over conventional methods for identification and trace analysis of organic materials. The method involves detection of fragment or daughter ions which arise from spontaneous or collisionally activated decomposition of parent ions in a field free region of the spectrometer. The main advantages are the additional information provided in the form of generic relationships between ions in the mass spectrum and the high specificity which can be achieved. In many cases, data obtained by ms/ms is sufficient to differentiate between isomeric structures. Although the ion intensity observed by ms/ms methods is considerably lower than with conventional MS, the reduction in chemical noise is generally sufficient to allow detection of compounds at low levels by direct mixture analysis.
GRA

36 LASERS AND MASERS

Includes parametric amplifiers.
For related information see also *76 Solid-State Physics*.

N88-17974# Los Alamos National Lab., N. Mex.
CONCEPTUAL DESIGNS OF A 50 NM FEL (FREE-ELECTRON LASER) OSCILLATOR AND A 20-40 NM SASE (SELF-AMPLIFIED SPONTANEOUS EMISSION) AMPLIFIER
John C. Goldstein, Brian D. McVey, and C. James Elliott 1987 20 p Presented at the 9th International Free-Electron Laser Conference, Williamsburg, Va., 14 Sep. 1987
(Contract W-7405-eng-36)
(DE88-003150; LA-UR-87-3964; CONF-8709110-11) Avail: NTIS HC A03/MF A01

This paper consists of two parts: the conceptual design and optical performance characteristics of a grazing angle-of-incidence ring resonator utilizing multifaceted metal mirrors for use with a 50 nm rf-linac-driven XUV FEL oscillator; and electron beam and wiggler requirements for a self-amplified spontaneous emission (SASE) amplifier to produce high power in the 20 to 40 nm wavelength range. The basis for these studies is the 3-d FEL simulation code FELEX which is used to derive tolerances on mirror figure and thermal distortion, alignment sensitivity, and alternative output coupling methods. The sensitivity of the output characteristics of an XUV FEL SASE amplifier to wiggler field errors is also studied.
DOE

N88-17975# Los Alamos National Lab., N. Mex.
EMITTANCE STUDIES AT THE LOS ALAMOS NATIONAL LABORATORY FREE-ELECTRON LASER (FEL)
B. E. Carlsten, D. W. Feldman, A. H. Lumpkin, W. E. Stein, and R. W. Warren 1987 27 p Presented at the 9th International Free-Electron Laser Conference, Williamsburg, Va., 14 Sep. 1987
(Contract W-7405-eng-36)
(DE88-003146; LA-UR-87-3046; CONF-8709110-13) Avail: NTIS HC A03/MF A01

Recent emittance studies at the Los Alamos Free-Electron Laser (FEL) have indicated several areas of concern in the linac and beamline feeding the wiggler. Four emittance growth mechanisms of special importance have been studied. First, a rapid growth of the electron beam's emittance immediately after the spherical gridded Pierce gun resulted, in part, from the long time required for our pulsing electronics to ramp the grid voltage up at the start and down at the end of the pulse, which created a pulse with a cosine-like current distribution as a function of time. The growth was compounded by the extremely small radial beam size (almost a waist) leaving the gun. In addition, we saw evidence of electrostatic charging of the insulators in the gun, reducing the quality of the electron beam further. Second, the action of the

solenoidal focusing fields in the low-voltage bunching region was studied, and criteria for a minimum emittance growth were established. Third, maximum misalignment angles and displacements for various elements of the beamline were calculated for the desired low emittance growth. Finally, emittance growth in the horizontal dimension through the nonisochronous bend caused by varying energy depression on the particles due to longitudinal wake fields was both calculated and observed. In addition, we measured energy depressions caused by the wake fields generated by various other elements in the beamline. Strategies were developed to relieve the magnitude of these wake-field effects. DOE

N88-17976# Oregon Univ., Eugene.
MONITORING INTERFACIAL DYNAMICS BY PULSED LASER TECHNIQUES Annual Report
G. Richmond 1987 5 p
(Contract DE-FG06-86ER-45273)
(DE88-003362; DOE/ER-45273/1) Avail: NTIS HC A02/MF A01

Several types of materials have been surveyed including thin film and layered semiconductors as well as a metal and semimetal. Second harmonic (SH) generation measurements on these materials were made using both nanosecond (Q-switched) and picosecond (mode-locked) pulsed Nd:YAG lasers with appropriate gated or photon counting detection. Initial studies were performed under steady state conditions in order to optimize the experiments for time-resolved studies. SHG were also extended to the time domain. A means of monitoring surface structure and reconstruction phenomena in-situ was developed. This discovery now opens a broad new area of dynamic interfacial measurements to be done in-situ. DOE

N88-17977# Lawrence Livermore National Lab., Calif.
APPLICATION OF STATE-MULTIPOLE HEISENBERG EQUATIONS TO RAMAN EXCITATION DYNAMICS
B. W. Shore, R. Sacks, and S. N. Dixit 10 Sep. 1987 46 p Presented at the International Conference on Multiphoton Processes, Boulder, Colo., 6 Mar. 1987
(Contract W-7405-eng-48)
(DE88-003828; UCRL-96136; CONF-8703217-1) Avail: NTIS HC A03/MF A01

Description of detailed temporal excitation dynamics for coherent excitation, such as is produced by idealized laser radiation, contrasts with evaluation of rate coefficients by means of generalized Golden Rule procedures; it requires an appropriate time-dependent Schroedinger equation. When the atom undergoing excitation is also affected by incoherent processes, such as collisions, this equation no longer suffices. The Heisenberg equations, or equivalent density-matrix equations, permit treatment in which coherence and incoherence play comparable roles in the excitation dynamics. Unlike rate equations, such equations must incorporate complexities that originate in the orientation degeneracy expressed by magnetic quantum numbers. It has been known for some time that appropriate state-multipole operators can simplify the description of many phenomena connected with optical pumping. This memo discusses application of these multipole operators to the description of Raman (or more general multiphoton) coherent excitation. In some simple limiting cases the equations simplify, but in general one has a hierarchy of coupled multipole polarizations and coherences in place of the populations and coherences that occur as variables in nondegenerate systems. DOE

N88-17978# Sandia National Labs., Albuquerque, N. Mex.
MODERN PULSED WAVEMETERS
C. Reiser 1987 20 p Presented at the SPIE O-E Lase '88: Optoelectronics and Laser Applications in Science and Engineering, Los Angeles, Calif., 10 Jan. 1988
(Contract DE-AC04-76DP-00789)
(DE88-003875; SAND-87-2697C; CONF-880110-1) Avail: NTIS HC A03/MF A01

Several technologies are available for interferometrically measuring laser wavelength to the precision of a Doppler width. These include instruments based on Fabry-Perot etalons, Fizeau wedges, Michelson interferometers, and other novel schemes. The current state of the art of these instruments is reviewed. Two new pulsed wavemeter designs are presented, the solid Fizeau wedge and the index mismatched interferometer. These instruments exhibit accuracies in the 10 to the 6th power range, and are very compact and inexpensive to fabricate. DOE

N88-17979# Lawrence Livermore National Lab., Calif.
SPATIALLY RESOLVED X-RAY LASER SPECTRA AND DEMONSTRATION OF GAIN IN NICKEL-LIKE SYSTEMS
D. A. Whelan, C. J. Keane, B. J. MacGowan, D. L. Matthews, J. E. Trebes, and M. J. Eckart 25 Sep. 1987 9 p Presented at the 31st SPIE Annual International Technical Symposium on Optical and Optoelectronic Applied Science and Engineering, San Diego, Calif., 16 Aug. 1987
(Contract W-7405-eng-48)
(DE88-003957; UCRL-97420; CONF-8708110-29) Avail: NTIS HC A02

A recent series of experiments have provided spatially resolved near field images of several candidate X-ray lasing transition in neon-like, nickel-like, and hydrogen-like ions from laser-produced plasmas. From these time-gated, spatially, and spectrally resolved measurements the source size for the J = 0 - 1 and the J = 2 - 1 transitions in Ne-like selenium have been determined. Source regions as small as 50 microns have been observed on transitions with gain-length products greater than 9. In addition, we have obtained the first experimental evidence for the amplification of spontaneous emission in the nickel-like ions of europium and ytterbium. Gains of order 1/cm and gain-length products of up to 3.8 are observed on the J = 0 - 1, 4d-4p transitions in Eu + 35 at 65.26 and 71.00 A. Analogous transitions in Yb = + 42 have been identified and some evidence for ASE has been observed. DOE

N88-17980# TRW, Inc., Redondo Beach, Calif.
PHYSICS MODELING SUPPORT CONTRACT Final Report
30 Sep. 1987 170 p
(Contract W-7405-eng-48)
(DE88-004039; UCRL-15992) Avail: NTIS HC A08/MF A01

This document is the final report for the Physics Modeling Support contract between TRW, Inc. and the Lawrence Livermore National Laboratory for fiscal year 1987. It consists of the following projects: TIBER physics modeling and systems code development; advanced blanket modeling task; time dependent modeling; and free electron maser for TIBER II. DOE

N88-17981# Texas Univ., Austin. Dept. of Physics.
KINETIC STUDIES FOLLOWING STATE-SELECTIVE LASER EXCITATION Annual Performance Report, 15 Mar. 1987 - 14 Mar. 1988
J. W. Keto Nov. 1987 13 p
(Contract DE-FG05-84ER-13191)
(DE88-004094; DOE/ER-13191/8) Avail: NTIS HC A03/MF A01

The objective of this contract is the study of state-to-state, electronic energy transfer reactions following two-photon laser excitation. We have specifically been studying reactions of Xe $5p^56p$ because of their relevance to the XeCl excimer laser. We are studying deactivation reactions in collisions with heavy atoms such as Ar, Kr, and Xe and reactive collisions with chlorides. The reactants are excited by multiphoton laser absorption. Product channels are observed by their fluorescence, or in experiments in the coming months by laser induced fluorescence using a second color laser. Reaction rates are measured by observing the time dependent decay of signals from reactant and product channels. In addition we measure interaction potentials of the reactants by laser spectroscopy where the laser induced fluorescence or ionization is measured as a function of laser wavelength (excitation spectra) or by measuring fluorescence spectra at fixed laser frequencies with monochromators. The spectra are obtained in

the form of either lineshapes or individual lines from rovibrational transitions of bound states. DOE

N88-17982# Bern Univ. (Switzerland). Inst. fuer Angewandte Physik.
LASER PULSE WIDTH DEPENDENT SURFACE RIPPLES ON SILICON
D. Jost, W. Luethy, H. P. Weber, and R. P. Salathe 5 May 1986 26 p
(PB88-127311; MM:1985/86-LY-14) Avail: NTIS HC A03/MF A01 CSCL 20E

Scanned irradiation of a Si(111) crystal with a focused CW mode locked Argon or Nd:YAG laser to its melting threshold has generated a type of surface morphology, ripples, with a periodicity which is dependent on the laser pulse width. The authors interpret these ripples as being a thermoelastically generated surface acoustic wave frozen out on the crystal surface. GRA

N88-17983# Los Alamos National Lab., N. Mex.
PRELIMINARY INJECTOR, ACCELERATOR, AND BEAMLINE DESIGN FOR RF-LINAC-DRIVEN XUV FREE-ELECTRON LASERS
B. E. Carlsten and K. C. D. Chan 1987 30 p Presented at the 9th International Free-Electron Laser Conference, Williamsburg, Va., 14 Sep. 1987
(Contract W-7405-eng-36)
(DE88-003185; LA-UR-87-3092; CONF-8709110-18) Avail: NTIS HC A03/MF A01

The proposed Los Alamos National Laboratory XUV free-electron laser (FEL) facility requires exceptional beam quality at high peak currents. Although the beam quality needed for a demonstration machine lasing at 50 nm is not far from what can be expected with extensions of present linacs to higher energy, conventional injector technology will not meet the requirements needed for lasing at 12 or 4 nm. We have conceived a preliminary injector and accelerator design that will meet these requirements. Using the Los Alamos photoelectric injector, it appears that normalized 90 percent emittances of 24 pi mm mrad can be attained in a relatively straightforward manner, and emittances down to 4 doe mm dot mrad are possible. Beamline simulations have been performed with the particle-pushing code PARMELA, using particle-dump inputs from the particle-in-cell code ISIS. The latter models the photoelectric gun up to the range between 0.75 and 1 MeV. Designs including electron guns with Pierce geometries have also been studied. Using an injector with a large planar-cathode Pierce gun seems to satisfy the 50-nm lasing requirements. In addition, other beamline questions have been studied. DOE

N88-17984# Washington Univ., Seattle. Dept. of Applied Mathematics.
EXPLICIT APPROXIMATIONS FOR STRICTLY NONLINEAR OSCILLATORS WITH SLOWLY VARYING PARAMETERS WITH APPLICATIONS TO FREE ELECTRON LASERS
J. Kevorkian and Y. P. Li Aug. 1987 75 p
(Contract DE-AI05-86ER-25016)
(DE88-004116; DOE/ER-25016/6; TR-87-8) Avail: NTIS HC A04/MF A01

The first part of this paper summarizes the mathematical modeling of free electron lasers (FEL), and the remainder concerns general perturbation methods for solving free electron laser (FEL) and other strictly nonlinear oscillatory problems with slowly varying parameters and small perturbations. We review and compare the methods of Kuzmak-Luke and of near-identity averaging transformations. In order to implement the calculation of explicit solutions we develop two approximation schemes. The first involves use of finite Fourier series to present either the leading approximation of the solution or the transformation of the governing equations to a standard form appropriate for the method of averaging. In the second scheme we fit a cubic polynomial to the potential such that the leading approximation is expressible in terms of elliptic functions. The ideas are illustrated with a number of examples which are also solved numerically to assess the accuracy of the various approximations. DOE

N88-17985# Los Alamos National Lab., N. Mex.
EXTENSION OF NUCLEAR STRUCTURE DATA BASE SEARCHES FOR GAMMA-RAY LASER CANDIDATES
E. D. Arthur, D. G. Madland, and D. C. George Dec. 1987 4 p Presented at the SPIE O-E Lase '88: Optoelectronics and Laser Applications in Science and Engineering, Los Angeles, Calif., 10 Jan. 1988
(Contract W-7405-eng-36)
(DE88-004288; LA-UR-87-4214; CONF-880110-8) Avail: NTIS HC A02/MF A01

Results from a data base search of computerized nuclear structure libraries have been extended and augmented so as to expand the information available for nuclei suitable as gamma-ray laser candidates. The spectrum of nuclear levels occurring in deformed rotational nuclei have been calculated and have been used in conjunction with isomeric state data for odd-A systems. The results of this augmentation effort are presented with particular emphasis on results obtained for Lu-177, Hf-177, and Hf-179. Some possibly interesting cases were identified that met energy spacing criteria. However, significant hindrance factors exist which eliminate them for gamma-ray laser applications. DOE

N88-17986# Los Alamos National Lab., N. Mex.
A NUCLEAR STRUCTURE STUDY OF THE PROPOSED GAMMA-RAY LASER CANDIDATE NUCLEUS Re-186
D. G. Madland and D. D. Strottman 1988 12 p Presented at the SPIE O-E Lase '88: Optoelectronics and Laser Applications in Science and Engineering, Los Angeles, Calif., 10-15 Jan. 1988
(Contract W-7405-eng-36)
(DE88-004299; LA-UR-87-4297; CONF-880110-12) Avail: NTIS HC A03/MF A01

Results are presented of theoretical nuclear structure model calculations for the gamma-ray laser candidate nucleus Re-186. Our calculations of this odd-odd transitional nucleus are based on an axially-asymmetric (particle plus triaxial rotor) model for constructing the orbitals of the odd nucleons that couple under the influence of the residual neutron-proton interaction. We include pairing correlations in the determination of these orbitals by using the BCS approximation with newly determined pairing strengths. The matrix elements of the residual neutron-proton interaction are obtained using phenomenological spin-dependent delta function potentials of both surface and volume forms. We examine the sensitivity of the calculated low-excitation level structure of Re-186 to the strength of these potentials. Calculated energy levels of Re-186 will be presented and compared with experiment. The impact of our results on the proposed use of Re-186 as a gamma-ray laser will be discussed. In addition, based on these and other model calculations to be described, we assess the level of effort necessary in a full-scale theoretical search for a viable candidate nucleus for a gamma-ray laser. DOE

N88-17987# Los Alamos National Lab., N. Mex.
OVERVIEW OF APPLICATIONS OF LASER-INDUCED BREAKDOWN SPECTROSCOPY (LIBS)
D. A. Cremers 1987 7 p Presented at the ICALEO '87: Conference on Electro-optic Sensing and Measurement, San Diego, Calif., 8 Nov. 1987
(Contract W-7405-eng-36)
(DE88-004314; LA-UR-87-4033; CONF-8711118-1) Avail: NTIS HC A02/MF A01

Laser-induced breakdown spectroscopy (LIBS) is a method of performing elemental analyses of solids, liquids, and gases using the microplasma produced by a focused laser pulse. Because the microplasma is formed by optical radiation, LIBS has some important advantages compared to conventional laboratory based analytical methods. Three applications are discussed which use the LIBS method. DOE

N88-17988# Los Alamos National Lab., N. Mex.
BRIGHT SOURCE LASERS AND EXPERIMENTS AT VERY HIGH IRRADIANCE
Reed J. Jensen, Robert B. Gibson, Gottfried T. Schappert, Antoinette J. Taylor, Jeffrey P. Roberts, Donald E. Casperson, Larry A. Jones, George A. Kyrala, Peter H. Y. Lee, and James A. Cobble 1987 11 p Presented at the 8th International Workshop on Laser Interaction and Related Plasma Phenomena, Monterey, Calif., 27 Oct. 1987 Submitted for publication
(Contract W-7405-eng-36)
(DE88-004317; LA-UR-87-4015; CONF-871093-1) Avail: NTIS HC A03/MF A01

The Los Alamos Bright Source has been assembled to explore the effects of intense coherent ultraviolet radiation on matter. This ultra-high brightness excimer laser is used to study the response of atoms, ions, and plasmas to the unique conditions the laser can provide. Primary areas of interest include properties and behavior of highly energetic atomic species, studies of possible intense field-induced nuclear transitions, pumping for X-ray lasers, and incoherent X-ray sources. The project consists of two phases: Los Alamos Bright Source I (LABS I) that is now in operation and is producing experimental data at an intensity up to 7 x 10 to the 17th watts/sq cm with 25 mJ of radiation and LABS II that will deliver between .1 and 1 J at an intensity of 10 to the 18th to 10 to the 20th w/sq cm. At these high intensities we observe collisionless excitations to the KeV level. The exact nature of the excitation process is not known and is itself part of the investigation. Because of the coherent nature of the pump and the very large fields obtainable, new regimes of optical excitation can be expected and examined. Work is underway with LABS I to produce highly ionized species and measure their spectral and other properties. This equipment has proven to be highly reliable in the last year and should afford the opportunity for many basic studies. LABS II with its increased pulse energy and intensity will support studies involving larger pump volume and higher excitation levels. It should serve as a test bed for studies of pumping schemes for X-ray lasers. DOE

N88-17989# Howard Univ., Washington, D. C. Laser Chemistry Lab.
LASER STUDIES OF THE DYNAMICS OF FREE RADICAL REACTIONS Final Report
J. B. Halpern 1986 18 p
(Contract DE-FG05-84ER-13213)
(DE88-004431; DOE/ER-13213/10) Avail: NTIS HC A03/MF A01

Principal achievements of this research program have been: development of a series of photochemical sources for CN radicals. By choosing among sources and excitation wavelengths one can select the absolute and relative amounts of rotational, vibrational and translational energy in the nascent CN fragment; rates of reaction were measured for ground state CN radicals with O2, CH4, H2 and a variety of hydrocarbons were measured; rates of reaction were measured for the CN molecule in the first excited vibrational state with many molecules. In particular, it was found that there is an enormous increase of the reaction rate for the reaction with NO. Results for reaction rates are discussed using several parameterized models. Reactions with hydrocarbons seem to correlate with an attractive potential. DOE

N88-17990# Brookhaven National Lab., Upton, N. Y.
BETATRON OSCILLATIONS IN A FREE ELECTRON LASER
Li-Hua Yu and S. Krinsky Nov. 1987 10 p Presented at the 9th International Free-Electron Laser Conference, Williamsburg, Va., 14 Sep. 1987
(Contract DE-AC02-76CH-00016)
(DE88-004859; BNL-40507; CONF-8709110-19) Avail: NTIS HC A02/MF A01

A dispersion relation is used to study the effect of betatron oscillations on the gain of a guided mode in a free electron laser operating in the high-gain regime before saturation. We assume the electron beam to be matched to the natural focussing of a helical wiggler, and our treatment includes the effects of the finite energy spread and emittance of the electron beam, the transverse gradient in the wiggler, and the variation of the electromagnetic wave transverse phase experienced by the electrons due to betatron oscillations. DOE

N88-17991# Brookhaven National Lab., Upton, N. Y.
ENERGY TRANSFER STUDIES WITH LASERS
R. E. Weston, Jr. 1987 6 p Presented at the 3rd International Laser Science Conference, Atlantic City, N.J., 1 Nov. 1987
(Contract DE-AC02-76CH-00016)
(DE88-004864; BNL-40691; CONF-871147-9) Avail: NTIS HC A02/MF A01

Using pulsed lasers to produce energetic species, we have observed their interaction with other molecules in real time by absorption spectroscopy with a c-w infrared diode laser. This technique has been used to observe the vibrational excitation of carbon dioxide by energy transfer from azulene and azulene-d sub 8 excited to energies of 30,000 and 40,000 cm (-1) and the relative populations of the bending and antisymmetric stretching modes of CO sub 2 are found to be very nonstatistical. Diode laser spectroscopy of CO has also been utilized to determine the efficiency of energy transfer from O(1D) atoms to vibrations of CO excited to v = 1 through 4. DOE

N88-17992# Rochester Univ., N. Y. Inst. of Optics.
NONLINEAR OPTICS WITH BROAD-BAND LASERS Progress Report, 15 Jul. 1978 - 14 Apr. 1988
M. G. Raymer Jan. 1988 7 p
(Contract DE-FG02-87ER-13761)
(DE88-005026; DOE/ER-13761/1) Avail: NTIS HC A02/MF A01

During this reporting period several important results were obtained on the fluctuation dynamics of both continuous-wave (CW) and pulsed dye lasers, as well as their effects in certain nonlinear optical processes: (1) A new method discovered for producing optical pulses with broad bandwidths (5 GHz) and smooth, slowly varying amplitude. The bandwidth is determined purely by phase fluctuations. (2) A theoretical treatment of pulsed dye lasers was developed to explain intensity autocorrelation measurements. (3) The effects of laser bandwidth on the resonance fluorescence spectrum of a two-level atom were calculated. (4) The source of mode intensity fluctuations in a multimode, CW dye laser were shown, both experimentally and theoretically, to be caused by deterministic chaos, rather than quantum noise as had been previously assumed in the literature. DOE

N88-17993# Rochester Univ., N. Y. Inst. of Optics.
INSTABILITIES AND CHAOS IN A MULTIMODE, STANDING-WAVE, CW DYE LASER
M. G. Raymer, I. McMackin, C. Radzewicz, M. Beck, and Z. Deng 1987 4 p
(Contract DE-FG02-87ER-13761)
(DE88-005028; DOE/ER-13761/4) Avail: NTIS HC A02/MF A01

Experimental and theoretical investigations of a multimode, standing-wave, CW dye laser have been carried out. The dye laser studied is composed of a standard three-mirror, folded cavity, a single-plate birefringent tuner, and a sapphire dye jet nozzle. The laser spectrum is found to evolve by discrete transitions with increasing pump power, between spectra composed of three stable modes to spectra composed of many modes whose amplitudes fluctuate strongly. DOE

N88-17994# Institute for Defense Analyses, Alexandria, Va.
DYNAMICS OF COUPLED ELECTRON-NUCLEON MOTION IN A LASER FIELD
F. X. Hartmann, K. K. Garcia, J. K. Munro, Jr., and D. W. Noid 1987 7 p Presented at the 3rd International Laser Science Conference, Atlantic City, N.J., 1 Nov. 1987 Prepared in cooperation with ORNL, Tenn.
(Contract DE-AC05-84OR-21400)
(DE88-005063; CONF-871147-8) Avail: NTIS HC A02/MF A01

Energy transfer processes in single particle coupled nucleon-electron models interacting with an intense laser field are studied using semi-classical quantization of the coupled classical Hamiltonian. DOE

N88-17995# Maryland Univ., College Park. Dept. of Electrical Engineering
OPTICALLY CONTROLLED DEVICES AND ULTRAFAST LASER SOURCES FOR SIGNAL PROCESSING Final Report, 1 Jul. 1984 - 30 Jun. 1987
Chi H. Lee and P. T. Ho 30 Jun. 1987 108 p
(Grant AF AFOSR-0238-84)
(AD-A187417; AFOSR-87-1583TR) Avail: NTIS HC A06/MF A01 CSCL 09C

Progress to date is summarized as follows: (1) experimental confirmation has been made of the pulse formation mechanism in a laser modelocked by a slow saturable absorber; (2) it is shown analytically and experimentally that the degree of coherence is the same in a diode laser whether modelocked or singlemode at the same power; (3) the continuously operating phosphate Nd:glass laser has been modelocked for the first time ever to generate 7 ps pulses. These pulse have also been successfully amplified to J/pulse at 500 Hz rate. GRA

N88-17996# Stanford Univ., Calif. Lab. of Physics.
RESEARCH STUDIES ON EXTREME ULTRAVIOLET AND SOFT X-RAY LASERS Annual Technical Report, 1 Sep. 1985 - 31 Aug. 1986
S. E. Harris and J. F. Young Aug. 1987 7 p
(Contracts F49620-85-C-0101; MIPR-ARO-109-87)
(AD-A187506; ARO-22842.15-PH) Avail: NTIS HC A02/MF A01 CSCL 09C

This program investigated, both theoretically and experimentally, new approaches to constructing XUV and soft X-ray lasers; it is a continuation and extension of our work sponsored by the predecessor contracts. GRA

N88-17997# Naval Research Lab., Washington, D.C. Plasma Theory Branch.
TAPERED WIGGLER ANALYSIS OF HIGH GAIN FREE ELECTRON LASER OSCILLATORS Interim Report
W. P. Marable, C. M. Tang, and P. Sprangle 12 Dec. 1987 35 p
(AD-A187997; NRL-MR-5854) Avail: NTIS HC A03/MF A01 CSCL 09C

The development of lasers in which the active medium is a relativistic stream of free electrons has evoked much interest. The prospect of operating these continuously tunable, high gain devices at high efficiencies by appropriately tapering the wiggler field parameters has significantly increased the interest in these devices. Variable parameter wiggler free electron lasers have been previously considered for operation in the amplifier configuration and also in the micro-pulse, low gain operation in the oscillator configuration. The present analysis extends the range of application to the case of intense, long pulsed electron beams in which the self-consistently derived space charge potential (arising from the axial bunching of the particles in the beat wave) is not negligible. Also included in this analysis are arbitrarily relativistic beams (i.e., no ultra - relativistic beam approximation). We have obtained theoretical expressions for nonlinear efficiency and present a comparison of these results with a fully nonlinear simulation. GRA

N88-17998# University of South Florida, Tampa. Dept. of Physics.
SELF-PUMPED PHASE CONJUGATION IN A SUPERSONICALLY FLOWING MEDIUM Final Report, 15 Jul. 1984 - 14 Jul. 1987
N. Djeu Sep. 1987 11 p
(Grant AF AFOSR-0226-84)
(AD-A188281; AFOSR-87-1656TR) Avail: NTIS HC A03/MF A01 CSCL 09C

The feasibility of producing degenerate two wave mixing gain in a noninverted resonant medium with local response is investigated. According to theory, two wave mixing gain should be possible if the resulting index grating is shifted in space with respect to the intensity grating produced by the two crossed beams. A pulsed molecular beam valve operated at 100 C was used to produce the supersonically cooled I2 jet. To achieve the moving grating effect, the pump and probe beams were to be crossed in a plane containing the flow axis, with each beam nearly perpendicular to that axis. The pulsed beam valve produced a broad forward peaked distribution of molecules. The velocity distribution at any given point, however, was mainly along the direction of the line joining that point to the nozzle orifice. This was evidenced by the fluorescence pattern along the laser beam path, which consisted of sharp filaments across the laser beam corresponding to various hyperfine components of a single rotational transition Doppler tuned into resonance with the laser beam at various angles of inclination. Gain in the planned experiment would be observable only within a narrow range of detuning (obtained by crossing the pump and probe beams), and therefore only a small solid angle of the I2 jet is useful. Various nozzles were tried with the pulsed valve device. Under the best circumstances, an integrated absorption of only about 10 percent was measured. GRA

N88-17694*# Saint Mary's Coll., Notre Dame, Ind.
LASER INVESTIGATIONS FOR PAYLOAD G-652 PRIOR TO FILING PRE-FLIGHT ACCOMMODATION REQUIREMENTS
Joseph Bellina and M. C. Muckerheide (Saint Mary's Hospital, Milwaukee, Wis.) *In* NASA. Goddard Space Flight Center, The 1987 Get Away Special Experimenter's Symposium Feb. 1988 p 17-22 (For primary document see N88-17691 10-12)
Avail: NTIS HC A08/MF A01 CSCL 20E

N88-17837# Messerschmitt-Boelkow-Blohm G.m.b.H., Ottobrunn (West Germany). Abteilung Technologie, Forschung-Informations-/Mikrosysteme.
CALCULATION OF THE SPATIAL-TEMPORAL DEFORMATION OF LASER PULSES IN MULTIPLE SCATTERING [BERECHNUNG DER RAUM-ZEITLICHEN DEFORMATION VON LASERPULSEN BEI MEHRFACHSREUUNG]
Konrad Altmann *In its* Research and Development. Technical-Scientific Publications (1956-1987): Retrospective View and Prospects. Jubilee Edition on the Occasion of the 75th Anniversary of Dipl.-Engr. Dr.-Engr. E.H. Ludwig Boelkow 1987 p 119-126 In GERMAN (For primary document see N88-17819 10-31)
(MBB-Z-111/87) Copyright Avail: NTIS HC A14/MF A01

37 MECHANICAL ENGINEERING

Includes auxiliary systems (nonpower); machine elements and processes; and mechanical equipment.

N88-17999*# National Bureau of Standards, Gaithersburg, Md. Robot Systems Div.
NASA/NBS (NATIONAL AERONAUTICS AND SPACE ADMINISTRATION/NATIONAL BUREAU OF STANDARDS) STANDARD REFERENCE MODEL FOR TELEROBOT CONTROL SYSTEM ARCHITECTURE (NASREM) Final Report
J. S. Albus, H. G. McCain, and R. Lumia Jul. 1987 94 p Sponsored by NASA
(PB88-124773; NBS/TN-1235) Avail: NTIS HC A05/MF A01; also Avail: SOD $4.50 as SN003-003-02819-3 CSCL 13I

The NASA Standard Reference Model (NASREM) Architecture for the Space Station Telerobot Control System is described. It defines the functional requirements and high level specifications of the control system for the NASA Space Station document for the functional specification, and a guideline for the development of the control system architecture, of the IOC Flight Telerobot Servicer. The NASREM telerobot control system architecture defines a set of standard modules and interfaces which facilitates software design, development, validation, and test, and makes possible the integration of telerobotics software from a wide variety

of sources. Standard interfaces also provide the software hooks necessary to incrementally upgrade future Flight Telerobot Systems as new capabilities develop in computer science, robotics, and autonomous system control. GRA

N88-18000# Institut National des Sciences Appliquees de Lyon, Villeurbanne (France). Lab. d'Energetique et d'Automatique.
EXPERIMENTAL STUDY OF THERMAL LOADING AT THE WALL OF AN INDUSTRIAL DIESEL MOTOR Ph.D. Thesis [ETUDE EXPERIMENTALE DES CHARGES THERMIQUES AUX PAROIS D'UN MOTEUR DIESEL INDUSTRIEL]
Zouheir Massalkhi 1987 110 p In FRENCH
(ISAL-IDI-187-10; ETN-88-91629) Avail: NTIS HC A06/MF A01

A bibliographic study of the empirical formulae giving estimates for the heat transfer coefficient is presented. The different corresponding measuring techniques are discussed and a method to measure the local heat flux densities in the cylinder head is proposed. The fluxmeters are composed of differentially mounted thermocouples embedded in cones of the same wall material. It is shown that the minimum heat flux density occurs at mid stroke position. The heat flux densities in the cylinder head are four times higher than those in the sleeve. Correlation formulae for the local and global thermal densities are obtained as function of the fuel mass flow rate, the air density and the engine speed. ESA

N88-18001# George Washington Univ., Washington, D.C. School of Engineering and Applied Science.
RESEARCH ON FLUID DYNAMIC ENERGY SEPARATION Final Technical Report
Jun. 1987 13 p
(Contract DE-AS05-83ER-13142)
(DE88-002776; DOE/ER-13142/T1; GWU/SEAS-TR-ES-87-4)
Avail: NTIS HC A03/MF A01

A study has been made of fluid dynamic energy separation, an air conditioning and heating mechanism that has been found to promise important advantages of energy economy and mechanical simplicity. The fluid dynamic energy separator has only one moving part, a free spinning rotor. Air entering it is discharged through slanting orifices on its periphery, causing it to spin. The emerging air separates into hot and cold streams whose difference in temperature can be regulated as desired. The energy of the hot output is actually not in the form of heat but rather in the form of recoverable mechanical energy that, if not used for heating, may be utilized in the pressurization of supply air, thereby saving energy. DOE

N88-18002 Arizona State Univ., Tempe.
OPTIMAL DESIGN AND PARAMETER IDENTIFICATION OF FLEXIBLE ROTOR-BEARING SYSTEMS Ph.D. Thesis
Wen-Jeng Chen [1987] 187 p
Avail: Univ. Microfilms Order No. DA8722007

The problem of optimization and identification of flexible rotor-bearing systems is considered. The design problem is an iterative process in which the design variables are modified until the desired design objectives are achieved. Several automated design procedures are developed to implement the design problem of rotor systems. Design objectives considered include: optimal placement of system critical speeds, minimization of transmitted loads for steady unbalance using squeeze film dampers, optimal balancing, and identification of bearing parameters. The rotating assembly is modeled using finite element formulation. The static condensation and assumed modes methods are employed to reduce the degrees of freedom. Two gradient-based optimization techniques are used in the design procedures. Closed form expressions for the sensitivity coefficients are derived and used in each optimal design procedure. The feasibility and desirability of such automated design procedures are demonstrated by several numerical examples of large order rotor-bearing systems. The results show that the optimal design procedures are effective and economical in dealing with complicated rotor systems. It is also illustrated that the optimal design method is a viable alternative and may be more reliable and accurate than other conventional design procedures in the design and identification of rotor-bearing systems. Dissert. Abstr.

N88-18003 Arizona State Univ., Tempe.
DESIGN CONDITIONS AND WORKSPACE FOR THE GENERALLY-PROPORTIONED 3-HINGE SPHERICAL WRIST FOR ROBOTS Ph.D. Thesis
Mohamed Bahaa El-Dee Trabia [1987] 240 p
Avail: Univ. Microfilms Order No. DA8722033

A study of the manipulator spherical wrist and its plane workspace was developed for a tool plane which is generally oriented with respect to the axis of the outboard-most wrist joint. The problem was treated for wrist joints which can freely rotate and for joints, one or more of which, have a limited rotation range. The necessary conditions for determination of the boundaries of the wrist orientational workspace were obtained. Conditions for the wrist full orientation, where the wrist can position the tool at any desired orientation, were presented. The necessary conditions for determination of the boundaries of the wrist attitudinal workspace were obtained. Different techniques were used to determine the boundaries of the subset of the attitudinal workspace within which full rotation of the tool plane can be completed without approaching a singularity. The techniques used depended on using the determinant of the wrist Jacobian, the maximum angular speed of the wrist joints, and the maximum angular acceleration of the wrist joints. Comparison of these three techniques was presented graphically. Numerical examples on how to apply the different design conditions were provided. Dissert. Abstr.

N88-18004*# National Aeronautics and Space Administration. Marshall Space Flight Center, Huntsville, Ala.
AN ANALYSIS OF PENETRATION AND RICOCHET PHENOMENA IN OBLIQUE HYPERVELOCITY IMPACT
William P. Schonberg (Alabama Univ., Huntsville.), Roy A. Taylor, and Jennifer R. Horn Feb. 1988 31 p
(NASA-TM-100319; NAS 1.15:100319) Avail: NTIS HC A03/MF A01 CSCL 13I

An experimental investigation of phenomena associated with the oblique hypervelocity impact of spherical projectiles on multisheet aluminum structures is described. A model that can be employed in the design of meteoroid and space debris protection systems for space structures is developed. The model consists of equations that relate crater and perforation damage of a multisheet structure to parameters such as projectile size, impact velocity, and trajectory obliquity. The equations are obtained through a regression analysis of oblique hypervelocity impact test data. This data shows that the response of a multisheet structure to oblique impact is significantly different from its response to normal hypervelocity impact. It was found that obliquely incident projectiles produce ricochet debris that can severely damage panels or instrumentation located on the exterior of a space structure. Obliquity effects of high-speed impact must, therefore, be considered in the design of any structure exposed to the meteoroid and space debris environment. Author

N88-18005# Lawrence Livermore National Lab., Calif.
FLASH THRESHOLD OF SHOCKED ALUMINUM SILICOFLUORIDE
G. H. Bloom Nov. 1987 6 p
(Contract W-7405-eng-48)
(DE88-003978; UCID-21259) Avail: NTIS HC A02/MF A01

For a 0.5-mm polycarbonate flier striking a 0.5-mm polycarbonate target, we found that a velocity of 1.42 km/s was necessary to cause aluminum silicofluoride sprayed on the far surface to flash. We calculated that the pressure in the polycarbonate was 2.93 GPa. DOE

N88-18006# Mound Lab., Miamisburg, Ohio.
METAL MODIFICATION FOR IMPROVED GLASS-CERAMIC TO METAL SEALS: 1. AUGER RESULTS ON ION IMPLANTATION AND VAPOR DEPOSITION FILMS
W. E. Moddeman, R. T. Cassidy, J. C. Birkbeck, B. D. Barton, J.

A. Bailey, R. F. Salerno, and T. N. Wittberg 29 Jan. 1988 27 p
(Contract DE-AC04-76DP-00053)
(DE88-005244; MLM-3479) Avail: NTIS HC A03/MF A01

Auger electron spectroscopy was used to characterize the oxide passivation layers on Inconel 718 and 304L stainless steel coupons modified by one of the following techniques: (1) O-16(+) ion implantation, (2) vapor deposition of an aluminum coating followed by oxygen plasma treatment, or (3) vapor deposition of an aluminum coating followed by air oxidation at 650 C. The results showed that a passivated oxide layer was created in all cases. However, air oxidation at 650 C of the vapor-deposited aluminum coating has the best potential for obtaining an oxide layer thick enough (a minimum of 2000 A) to protect the metal during the sealing cycle and, ultimately, to produce a better glass-ceramic to metal seal. DOE

N88-18007*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.
CERAMIC BEARINGS FOR USE IN GAS TURBINE ENGINES
Erwin V. Zaretsky 1988 15 p Proposed for presentation at the 33rd International Gas Turbine and Aeroengine Congress and Exposition, Amsterdam, Netherlands, 5-9 Jun. 1988; sponsored by ASME
(NASA-TM-100288; E-3934; NAS 1.15:100288) Avail: NTIS HC A03/MF A01 CSCL 13I

Three decades of research by U.S. industry and government laboratories have produced a vast body of data related to the use of ceramic rolling element bearings and bearing components for aircraft gas turbine engines. Materials such as alumina, silicon carbide, titanium carbide, silicon nitride, and a crystallized glass ceramic have been investigated. Rolling-element endurance tests and analysis of full-complement bearings have been performed. Materials and bearing design methods have continuously improved over the years. This paper reviews a wide range of data and analyses with emphasis on how early NASA contributions as well as more recent data can enable the engineer or metallurgist to determine just where ceramic bearings are most applicable for gas turbines. Author

N88-18008*# Jet Propulsion Lab., California Inst. of Tech., Pasadena.
RECURSIVE FORWARD DYNAMICS FOR MULTIPLE ROBOT ARMS MOVING A COMMON TASK OBJECT
G. Rodriguez 15 Feb. 1988 40 p
(Contract NAS7-918)
(NASA-CR-182526; JPL-Publ-88-6; NAS 1.26:182526) Avail: NTIS HC A03/MF A01 CSCL 13I

Recursive forward dynamics algorithms are developed for an arbitrary number of robot arms moving a commonly held object. The multiarm forward dynamics problem is to find the angular accelerations at the joints and the contact forces that the arms impart to the task object. The problem also involves finding the acceleration of this object. The multiarm forward dynamics solutions provide a thorough physical and mathematical understanding of the way several arms behave in response to a set of applied joint moments. Such an understanding simplifies and guides the subsequent control design and experimentation process. The forward dynamics algorithms also provide the necessary analytical foundation for conducting analysis and simulation studies. The multiarm algorithms are based on the filtering and smoothing approach recently advanced for single-arm dynamics, and they can be built up modularly from the single-arm algorithms. The algorithms compute recursively the joint-angle accelerations, the contact forces, and the task-object accelerations. Algorithms are also developed to evaluate in closed form the linear transformations from the active joint moments to the joint-angle accelerations, to the task-object accelerations., and to the task-object contact forces. A possible computing architecture is presented as a precursor to a more complete investigation of the computational performance of the dynamics algorithms. Author

N88-18009# Colorado Univ., Boulder. Dept. of Electrical and Computer Engineering.
ROBUST CONTROLLER DESIGN FOR FLEXIBLE STRUCTURES
Renjeng Su and Nassim M. Arbouz 1987 13 p
(Grant AF-AFOSR-0198-86)
(AD-A187217; AFOSR-87-1561TR) Avail: NTIS HC A03/MF A01 CSCL 20K

This document considers the problem of control of a beam which is moving in the x-y plane. It extends from x=0 to x=L. The left end at x=0 is clamped to an actuator which moves the beam along the v-axis. The control input is the force u(t) in y direction. While moving, the beam may vibrate. Let z(t) denote the displacement of the left from y=0, and w(t,x), the displacement of the beam from the line y=z(t) at position x and time t. Suppose a position sensor is placed on the beam and the sensing output is v(t, sub 0)=z(t) + w(t,x0), where 0 less than x sub 0 less than L is the sensor location. We are interested in the case when the flexure w(t,x) of the beam is significant. The problem is to synthesize a feedback control law which moves the beam from one position to another in a stable manner. It is well known that when the sensor and the actuator are colocated a simple lead compensator suffices to produce a stable design. This result holds even when the beam dynamics are considered as a system with infinite zero-damping modes, and can be shown using root locus argument. This stabilization method may break down, however, when there is a positional gap between the sensor and actuator. In this case the classical compensation techniques are no longer effective. Time-domain optimization approaches based on state-space models have been applied to this problem. This article presents a case study of noncolocated beam control problem using frequency-domain optimization method proposed by Professor Kwakerna. GRA

N88-18010# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
AN EVALUATION OF EFFECTIVENESS OF PTFE (POLYTETRAFLUOROETHYLENE) TYPE FRICTION REDUCERS ON REDUCING FRICTION AND WEAR
Yiming Guo 25 Sep. 1987 22 p Transl. into ENGLISH from Guti Runhua (People's Republic of China), no. 2, 1986 p 94-104
(AD-A187440; FTD-ID(RS)T-0721-87) Avail: NTIS HC A03/MF A01 CSCL 07F

A friction reducer containing colloidal polytetrafluoroethylene (PTFE) is one of the new lubricating materials recently developed abroad for automobile engines. Reported are: (1) the effectiveness of friction reducers (three American products and one Chinese product) on the anti-friction and fuel-saving of Chinese multi-cylinder gasoline engines; and (2) the effectiveness of these friction reducers on the anti-wear of Chinese gasoline engines. The evaluations were conducted in Beijing, Shanghai, and Guangdong with identical test procedures. Results obtained from various methods at various places provide a better basis for correlation. These results prove that friction reducers are effective in reducing friction and wear, when applied to Chinese gasoline engines. It was found that the fuel consumption at a constant speed decreased about 4 percent, the fuel consumption during 100 km operation decreased about 3 percent and the wear of engine cylinder decreased about 10 percent to 40 percent. GRA

N88-18011# Maryland Univ., College Park.
TACTILE SENSING AND INVERSE PROBLEMS
R. Yang and P. S. Krishnaprasad Oct. 1987 32 p
(Grants AF AFOSR-0073-87; NSF OIR-85-00108)
(AD-A187464; AFOSR-87-1435TR) Avail: NTIS HC A03/MF A01 CSCL 12I

In recognizing a grasped object or to grasp an object stably with a multifingered robotic hand, tactile sensors mounted on robot fingers have been identified as essential detecting tools. In general, grasp stability has two requirements: sliding avoidance and excess force avoidance. Hence, it is required that a tactile sensor be able to detect the nature of the force distribution which exists between the surface of the grasped object and the robot finger.

Several kinds of tactile sensors have been designed based on electro-optics, piezoresistive, or piezoelectric properties, etc. Typically, these sensors are not used to measure the contact force directly, but to measure the interior strain or stress in an elastic finger pad. When sharp and rigid objects, e.g., a wedge indentor, indent an elastic material, very high stress is developed at the contact surface. This stress is reduced by distance from the contact area, so a fragile sensor would be better protected by a layer of soft material. Another advantage of using an elastic covering is that the contact area becomes large so that grasp stability may be enhanced and the features of grasped objects better distinguished. The goal of this paper is to study how a surface force profile may be estimated from the information on strain or stress distribution detected by tactile sensors. This problem is referred to as the inverse problem since we can consider the stress or strain within an elastic material as the response due to surface loading. GRA

N88-18012# Maryland Univ., College Park.
THE DYNAMICS OF TWO COUPLED RIGID BODIES
R. Grossman, P. S. Krishnaprasad, and Jerrold E. Marsden Oct. 1987 7 p
(Grants AF AFOSR-0073-87; NSF OIT85-00108)
(AD-A187592; AFOSR-87-1432TR) Avail: NTIS HC A02/MF A01 CSCL 13E

A Poisson bracket is derived on the phase space so(3) x so(3) x SO(3) such that the dynamics of two three dimensional rigid bodies coupled by a ball and socket joint can be written as a Hamiltonian system. A Poisson bracket on the phase space is introduced. SO(3) is the dual of the Lie algebra of SO(3), so that the dynamics of two rigid bodies coupled by a ball and socket joint can be written as the Hamilitonian system H = (F,H). This sets the stage so that the stability and asymptotics of the system can be studied using the energy Casimir method as in Holm, Marsden, Ratiu and Weinstein 1985 and Krishnaprasad 1985; so that chaotic solutions can be found using the Melnikov method such as in Holmes and Marsden 1983; so that bifurcations of the system can be described using the techniques in Golubitsky and Stewart 1986 and Lewis, Marsden and Ratiu 1986; and so that control issues can be studied, as in Sanchez de Alvarez 1986. GRA

N88-17861# Messerschmitt-Boelkow-Blohm G.m.b.H., Schrobenhausen (West Germany). Defense Systems Group.
PENETRATION THEORY FOR INCLINED AND MOVING SHAPED CHARGES
Manfred Held and Rainer Fischer *In its* Research and Development. Technical-Scientific Publications (1956-1987): Retrospective View and Prospects. Jubilee Edition on the Occasion of the 75th Anniversary of Dipl.-Engr. Dr.-Engr. E.H. Ludwig Boelkow 1987 p 279-284 (For primary document see N88-17819 10-31)
(MBB-UA-940/86) Copyright Avail: NTIS HC A14/MF A01

38 QUALITY ASSURANCE AND RELIABILITY

Includes product sampling procedures and techniques; and quality control.

N88-18013# Northrop Corp., Hawthorne, Calif. Aircraft Div.
DURABILITY AND DAMAGE TOLERANCE OF ALUMINUM CASTINGS Interim Report No 1, Sep. 1985 - 31 May 1987
M. W. Ozelton and G. R. Turk Sep. 1987 108 p Prepared in cooperation with Ohio State Univ., Columbus, Aluminum Co. of America, Corona, Calif., Hitchcock Industries, Inc., Minneapolis, Minn. and Fansteel Wellman Dynamics, Creston, Iowa
(Contract F33615-85-C-5015)
(AD-A186444; NOR-87-85) Avail: NTIS HC A06/MF A01 CSCL 11F

The results from the initial 21 months of the program are presented. They include: (1) an assessment of nondestructive methods for castings, and (2) the effect of process variables on the mechanical properties and microstructure of A357-Tb and A201-T7. A new ultrasonic nondestructive inspection (NDI) method called Frequency Attenuation Inflection (FAI) was evaluated for determining the type and amount defects in A357 and A201 aluminum castings. A low frequency eddy current method for detecting the presence of cracks through face sheet and fasteners was assessed. Relationship among chemical composition, heat treatment, solidification rate, microstructure, and mechanical properties of the premium quality casting alloys A357-T6 and A201-T7 were investigated. GRA

N88-18014# Atomic Energy Research Establishment, Harwell (England). Instrumentation and Applied Physics Div.
THE DEVELOPMENT OF EMISSION TOMOGRAPHY FOR THE NUCLEAR INDUSTRY
J. Huddleston, I. G. Hutchinson, S. F. Burch, J. K. Perring, and G. Davies (Surrey Univ., London, England) Nov. 1986 63 p
(AERE-R-12319; FPRSC(86)P6; HL86/1431) Avail: NTIS HC A04/MF A01

Single photon emission computer tomography (SPECT) is a relatively recent technique of nondestructive examination pioneered in the medical field and currently finding applications in the nuclear industry. The technique provides information relating to the spatial distribution of one or more radionuclides within an object. However, a number of problems is inherent in the technique, chiefly associated with the attenuation of radiation prior to detection. This report describes work done to demonstrate the technique, using both real and simulated data; problems are discussed and ways suggested to find satisfactory solutions. Author

N88-18015# Atomic Energy Research Establishment, Harwell (England). Materials Physics and Metallurgy Div.
ACOUSTIC EMISSION-MICROSTRUCTURAL RELATIONS IN FERRITIC STEELS. PART 3: THE EFFECT OF INCLUSION CONTENT
H. N. G. Wadley and C. B. Scruby Dec. 1986 42 p Sponsored in part by MoD Procurement Executive, United Kingdom
(AERE-R-12041; HL86/1452) Avail: NTIS HC A03/MF A01

A comparison of the acoustic emission accompanying the deformation and fracture of high and low sulfur steels subjected to various heat treatments indicates that the decohesion of MnS inclusions from the matrix acts as a source of detectable signals. The inclusion component of the emission shows some correlation with yield strength. The data are consistent with the hypothesis that inclusion decohesion is strain controlled. Inclusion contents and carbide distribution interact to influence the transition from alternating shear to cup and cone fracture at ambient temperature. Author

N88-18016# Atomic Energy Research Establishment, Harwell (England). Materials Physics and Metallurgy Div.
ACOUSTIC EMISSION MEASUREMENTS OF PWR WELD MATERIALS WITH INSERTED DEFECTS
C. B. Scruby and K. A. Stacey Jan. 1987 43 p
(AERE-R-12386; HL87/1123) Avail: NTIS HC A03/MF A01

Ten specimens of A533B pressure vessel steel containing realistic welding defects have been monitored for acoustic emission during monotonic loading. The detection system consisted of an array of four point-contact broad-band transducers whose outputs were fed via broad-band amplifiers into a multi-channel digital recording system. Specimens containing cracks, slag inclusions and porosity all generated copious emission over a range of loads, while defect-free specimens only emitted when general yield had been reached. Three-dimensional location techniques have been used to image the different types of defect and show how the concentration of stress, as evidenced by emission activity, moved to different regions of the defect during testing. Only limited analysis using source radiation patterns was possible, which confirmed the events to have broadly the character of mode I crack opening. Author

N88-18017# Chicago Univ., Ill.
INSTRUMENTATION AND QUANTITATIVE METHODS OF EVALUATION Progress Report, 15 Jan. - 14 Sep. 1987
R. N. Beck Sep. 1987 22 p
(Contract DE-FG02-86ER-60418)
(DE87-013639; DOE/ER-60418/T1) Avail: NTIS HC A03/MF A01

This report describes various research projects involving NMR imaging techniques. Included are brief descriptions of improvements to existing equipment, modifications in computer codes controlling image processing, and methods for improving the accuracy of diagnostic techniques. DOE

N88-18018# Sandia National Labs., Albuquerque, N. Mex.
FLAW IDENTIFICATION FROM FORCED VIBRATION TESTING
J. D. Rogers and J. R. Hollingshead 1988 16 p Presented at the 6th International Modal Analysis Conference, Orlando, Fla., 1 Feb. 1988
(Contract DE-AC04-76DP-00789)
(DE88-002641; SAND-87-1360C; CONF-880220-7) Avail: NTIS HC A03/MF A01

A continuous system approach to the vibration characteristics of a symmetrically slotted beam has been developed. The beam was modelled as a Bernoulli-Euler beam with a reasonable stress distribution associated with the slots. The equation of motion was developed and resonant frequencies obtained from Rayleigh's Quotient. An experimental study of an aluminum beam with symmetrical slots was performed. The resonant frequency and apparent mass (a measure of damping) were measured. Reasonably good correlation in natural frequencies between theory and experiment was obtained. The reduction in natural frequency was a more sensitive indicator of damage than was the increase in damping. DOE

N88-18019# International Atomic Energy Agency, Vienna (Austria).
TRAINING GUIDELINES IN NON-DESTRUCTIVE TESTING TECHNIQUES
Feb. 1987 211 p
(DE88-700613; IAEA-TECDOC-407) Avail: NTIS (US Sales Only) HC A10/MF A01

In 1982, a regional project was started with the principal objective of assisting the countries in the Latin American and Caribbean region to reinforce autonomous nondestructive testing (NDT) capability through regional cooperation. One essential component of this project has been the harmonization of training through the development and use of course syllabi by the 17 countries now participating in the project. To this end, a Regional Working Group was formed and one of its tasks is the development of these syllabi for the more common NDT methods. This publication is a collection of the training programs elaborated to date which have so far been followed by some 10,000 persons in the region who have received training in NDT as a direct result of the project. These syllabi take into account the development work done by the International Committee for Non-destructive Testing and many national training programmes, and are meant to be an objective guide to assist in the formation of NDT personnel. DOE

N88-18020# National Bureau of Standards, Gaithersburg, Md.
INSTITUTE FOR MATERIALS SCIENCE AND ENGINEERING, NONDESTRUCTIVE EVALUATION: TECHNICAL ACTIVITIES 1987
H. Thomas Yolken 1987 84 p
(PB88-153655; NBSIR-87/3611) Avail: NTIS HC A05/MF A01 CSCL 14D

A review of the Nondestructive Evaluation Program at NBS, for fiscal year 1987, is presented in the annual report. A key component of the NBS nondestructive evaluation program is providing traceability for NDE measurements to national measurement standards. To this end, NBS conducts research to achieve an adequate understanding of the physical basis of the NDE measurement techniques and procedures that require standardization. E.R.

N88-18021# Stanford Univ., Calif. Lab. of Physics.
APPLICATION OF NONDESTRUCTIVE TESTING TECHNIQUES TO MATERIALS TESTING Annual Report, 1 Jan. - 31 Dec. 1986
G. S. Kino Nov. 1987 10 p
(Grant AF AFOSR-0063-84)
(AD-A187645; GL-4294; AFOSR-87-1927TR) Avail: NTIS HC A02/MF A01 CSCL 20F

The aim of this work during the last year has been to carry out research on new types of optical microscopes which gives better resolution in both the transverse and range directions than standard high-quality optical microscopes. The reason for carrying out such studies is that there is a need for measurements of semiconductor profiles with submicron resolution. The scanning electron microscope has excellent transverse resolution, but poor range resolution; it must be used in a vacuum, and it can damage sensitive semiconductor materials. We have been working with new scanning optical microscope concepts which provide excellent range resolution, of the order of 10nm, less, and transverse resolutions of the order of 200nm, and with computer processing as good as 130nm. GRA

N88-18022*# Lockheed-Georgia Co., Marietta.
NAVIGATION RECOVERY BLOCK DESIGN DESCRIPTION
E. F. Hitt and S. A. Prater (Battelle Columbus Labs., Ohio.) Mar. 1987 84 p Prepared in cooperation with Battelle Columbus Labs., Ohio and FAA, Atlantic City, N.J.
(Contract NAS2-11853)
(NASA-CR-182473; NAS 1.26:182473; AD-A187840; DOT/FAA/CT-87/15) Avail: NTIS HC A05/MF A01 CSCL 14D

The recovery block approach to fault-tolerant software is described and its application to a flight navigation problem illustrated. The navigation problem using VOR (Visual Omnirange) and DME (Distance Measuring Equipment) is developed, especially with regard to its software specification and implementation needs. Related aspects of the recovery block approach are reviewed, and an ADA implemented source code is presented. Author

39 STRUCTURAL MECHANICS

Includes structural element design and weight analysis; fatigue; and thermal stress.

For applications see *05 Aircraft Design, Testing and Performance* and *18 Spacecraft Design, Testing and Performance.*

N88-18023# Aeronautical Research Labs., Melbourne (Australia).
APPLICATIONS OF ENERGY DENSITY THEORY IN CYCLIC PLASTICITY
J. Paul and L. Molent 25 Aug. 1987 19 p
(AD-A186947; ARL-STRUC-TM-469; DODA-AR-004-552) Avail: NTIS HC A03/MF A01 CSCL 07D

This paper discusses the application of energy density theory to a variety of problems associated with cyclic plasticity. Attention is focused on problems related to fatigue life enhancement procedures, and on understanding the mechanisms which govern failure. GRA

N88-18024# Aeronautical Research Labs., Melbourne (Australia).
COMPUTED STRESS AND STRAIN DISTRIBUTIONS UNDER INTERFERENCE FIT AND AFTER COLDWORKING
R. P. Carey 25 Aug. 1987 31 p
(AD-A186950; ARL-STRUC-TM-466; DODA-AR-004-548) Avail: NTIS HC A03/MF A01 CSCL 11F

Stress and strain distributions are computed by finite element method for various levels of interference fit and for the unloaded,

or coldworked condition. The assumed material properties represent a steel pin interacting with an aluminum alloy plate. GRA

N88-18025# Georgetown Univ., Washington, D.C. Dept. of Mathematics.
BOUNDARY STABILIZATION OF THIN ELASTIC PLATES
John E. Lagnese 1987 16 p
(Grant AF AFOSR-0162-86)
(AD-A187123; AFOSR-87-1562TR) Avail: NTIS HC A03/MF A01 CSCL 20K

In this paper we shall consider the question of uniform stabilization of thin, elastic plates through the action of forces and moments on the edge of the plate (or on a part of the edge of the plate). Two particular plate models will be considered: the classical fourth order Kirchoff model, but incorporating rotational inertia, and the sixth order Mindlin-Timoshenko model. The difference in the two models, from a physical point of view, is that the M-T model incorporates transverse shear effects while the Kirchhoff model does not. Actually, the M-T model is a hyperbolic system three coupled second order partial differential equations in two dependent variables. The unknowns, denoted by w, psi, phi are the vertical component w of displacement and angles which are measures of the amount of transverse shear. The three equations are coupled through terms which are multiples of a factor K called the coefficient of elasticity in shear. GRA

N88-18026# United Kingdom Atomic Energy Authority, Harwell (England). Materials Development Div.
COST 501 PROJECT UK10 PART 3: THERMAL FATIGUE DAMAGE OF FECRALLOY STEEL-SPRAYED AND CO-EXTRUDED TUBING
E. Lang (Joint Research Centre of the European Communities, Petten, Netherlands), M. J. Bennett, B. Hudson, and A. T. Tuson Mar. 1987 69 p
(AERE-R-12230; HL87/1100) Avail: NTIS HC A04/MF A01

The influence of severe thermal cycling upon the dimensional stability of both Fecralloy steel coated and clad representative substrate materials, 2(1)/4Cr1Mo-steel, Incoloy 800H and type 321 stainless steel was investigated. Thermal cycling eventually caused delamination of the flamesprayed Fecralloy steel coating but the dimensions of the substrates remained unchanged. In contrast thermal cycling caused varying degrees of dimensional distortion of duplex and triplex coextruded tube sections depending on the substrate materials. The distortions depend on the differential thermal expansion between the substrate materials and the Fecralloy steel and on their relative strengths and are explained by a simple ratchet model. This further predicts that the magnitude of the temperature cycle, the upper cycle temperature and the relative thickness of the substrate and overlayer are critical parameters in determining the overall distortion; the influence of these parameters has been substantiated experimentally. In practical terms, the use of these steels with the exception of the 2(1)/4Cr1Mo steel at temperatures greater than 750 C should be minimized. Author

N88-18027# Atomic Energy Research Establishment, Harwell (England). Materials Physics and Metallurgy Div.
THE MEASUREMENT OF STRESS IN STEELS OF VARYING MICROSTRUCTURE BY BARKHAUSEN AND MAGNETO-ACOUSTIC EMISSION
D. J. Buttle, C. B. Scruby, G. A. D. Briggs, and J. P. Jakubovics (Oxford Univ., England) Apr. 1987 68 p
(AERE-R-12387; HL87/1108) Avail: NTIS HC A04/MF A01

Magneto-acoustic emission (MAE) and Barkhausen emission (BE) were measured as a function of applied magnetic field and tensile stress from mild steel samples in a wide range of heat treatments, in order to develop a technique to measure stress without prior knowledge of the microstructure. The results are supplemented by measurements of magnetic coercivity and mechanical hardness. The MAE is found to decrease with increasing applied stress, while the variation of BE is more complicated. The amplitudes of both MAE and BE, as well as the coercivity and hardness are also found to depend on the microstructure to varying degrees. Tempered martensitic structures give a weak MAE signal which is more senitive to tempering temperature than applied stress, whereas the BE increases with stress for temperatures below 500 C and decreases above. The dependence of MAE and BE on magnetic field are discussed in terms of domain wall nucleation and irreversible motion in ferrite at higher fields, and irreversible wall motion through martensite or pearlite at lower fields. The results imply that MAE can be used alone to measure stress provided the general form of the microstructure is known: otherwise BE can be used as an additional technique to resolve any ambiguity. Author

N88-18028 Illinois Univ. at Urbana-Champaign, Savoy.
SOME ASPECTS OF THE MECHANICS AND MECHANISMS OF DYNAMIC BRITTLE FRACTURE Ph.D. Thesis
Sundar Mangalore Kamath 1987 306 p
Avail: Univ. Microfilms Order No. DA8721673

The problem of brittle fracture in a finite-length beam under quasi-static flexure was studied. The gradient stress field and boundary wave reflections present in this configuration lead to highly transient propagation which includes several intermittent arrests. The results for PMMA (Plexiglass) highlight the problems of characterizing history dependent crack growth in rate-sensitive materials. The strong inertia effects observed during fracture were caused by boundary reflections of the unloading extensional waves and the Rayleigh surface waves emitted at fracture. Macroscopic measurements were supported by extensive fractography to gain insight into the mechanisms. Dissert. Abstr.

N88-18029 Cornell Univ., Ithaca, N.Y.
PIEZOELECTRIC LAMINATES FOR TORSIONAL AND BENDING MODEL CONTROL: THEORY AND EXPERIMENT Ph.D. Thesis
Chih-Kung Lee 1987 213 p
Avail: Univ. Microfilms Order No. DA8724154

A piezoelectric laminate theory that uses the piezoelectric phenomenon to effect distributed control and sensing of both bending and torsional vibration of a flexible torsion beam has been developed. This newly developed theory is capable of modeling the electro-mechanical and mechano-electrical behavior of a laminate. Emphasis is on the use of the piezoelectric and ferroelectric properties of the lamina to achieve both torsion and bending coupling between the applied voltage and the deformation in the torsion beam. This theory is applied to the commercially available polyvinylidene fluoride (PVDF) thin film which is used as the piezoelectric lamina. Dissert. Abstr.

N88-18030 Case Western Reserve Univ., Cleveland, Ohio.
THEORETICAL ANALYSIS OF ADHESIVE FRACTURE AND CRACK-DAMAGE INTERACTIONS Ph.D. Thesis
Mongi BenOuezdou [1987] 118 p
Avail: Univ. Microfilms Order No. DA8722214

A further development of the Crack Layer (CL) theory which models the propagation of a crack and its surrounding damage is presented. First, the interaction of the main crack with its surrounding damage is analyzed. The solution procedure is illustrated for the case of the interaction of an array of horizontal crazes with a main crack (in a sheet of Polystyrene). It is found that, depending on the location of the craze, it may either amplify or shield the propagating crack tip. The results of the overall effect suggest an alternative approach to Dugdale-Barenblatt models which postulate the cancellation of the stress singularity at the crack tip. On a different scale, fracture is viewed as a sequence of a fast process corresponding to damage zone evolution. Constitutive equations for CL propagation are formulated within the framework of thermodynamics of irreversible process. The balance between energy available, which is the energy release rate, and the energy required for crack propagation, which is the resistance of the material due to the presence of the damage, determines the fracture toughness. Comparisons with the experimental studies are presented. Dissert. Abstr.

N88-18031 Stanford Univ., Calif.
DYNAMIC RESPONSE OF SOME STRUCTURAL ELEMENTS FABRICATED FROM A NON-LINEAR ELASTIC MATERIAL Ph.D. Thesis
Siu-Lun Chow [1987] 128 p
Avail: Univ. Microfilms Order No. DA8722980

Nonlinear vibrations of continuous systems have been studied in recent years. Herein, the influence of material nonlinearity on the dynamic behavior and the steady state solutions near resonance of some structural elements, namely, a simple supported beam, a free floating ring and a simply supported column. Based upon the framework of the Galerkin procedure and the multiple scales method, the frequency response curves of different structural elements are computed. In order to assure stability of the steady state response, small perturbations were assumed and whether these perturbations will grow in time was determined. The results show that for the system considered the amplitude of a lower natural mode can be several times higher than the amplitude of the directly excited mode, depending on the forcing frequency and the magnitude of the nonlinearity. This phenomenon is not predicted by the classical theory which does not include nonlinear coupling effects. The problem of passage through resonance which concerns the deviation of the system's response from the steady state solution caused by a time dependent excitation frequency is also studied. Dissert. Abstr.

N88-18032 Iowa Univ., Iowa City.
DESIGN SENSITIVITY ANALYSIS OF NONLINEAR STRUCTURAL SYSTEMS AND NUMERICAL IMPLEMENTATION WITH ESTABLISHED FINITE ELEMENT CODES Ph.D. Thesis
Jose Luis Trigo Santos [1987] 148 p
Avail: Univ. Microfilms Order No. DA8721440

A unified approach is presented for design sensitivity analysis of nonlinear structural systems that include truss, beam, plane elastic solid, and plate components, for sizing and shape design variables. Both geometric and material nonlinearities are treated. Sizing design variables, such as thickness and cross-sectional areas of components of individual members and built-up structures, are considered. A distributed parameter structural design sensitivity analysis approach is used. Design variables that specify the shape of components of individual members and built-up structures are treated. Using the approaches and an adjoint variable method, sizing and shape design sensitivity expressions, in terms of design variations, are derived in the continuous setting and are evaluated numerically using results of finite element analysis. Both total and updated Lagrangian formulations of nonlinear solid mechanics analysis are used for design sensitivity analysis results with established finite element codes is presented. Feasibility of the numerical method is shown through several problems, including built-up structures. Accurate design sensitivity predictions are obtained without the uncertainty of numerical accuracy and high cost associated with selection of finite difference perturbations. Dissert. Abstr.

N88-18033# Sandia National Labs., Albuquerque, N. Mex.
QUALIFICATION OF FREQUENCY RESPONSE FUNCTIONS USING THE RIGID-BODY RESPONSE
D. O. Smallwood and J. P. Lauffer 1987 7 p Presented at the 6th International Modal Analysis Conference, Orlando, Fla., 1 Feb. 1988
(Contract DE-AC04-76DP-00789)
(DE88-000745; SAND-87-1634C; CONF-880220-1) Avail: NTIS HC A02

The response of a structure at low frequencies with free boundary conditions is dominated by the rigid-body modes. The displacement shapes obtained from the low frequency values of the frequency response functions can be compared with ideal rigid-body motion to point out errors in the measurements. Insight is enhanced when the comparisons are made in the coordinate system of the measurements. Without this procedure intuition can rarely determine the proper rigid-body response at each measurement location. Typical errors identified are scaling errors, errors in location or direction, measurements with poor dynamic range and other instrumentation problems. The procedure is particularly useful when the test object is multidimensional, has a complicated geometry, has measurements in other than rectangular coordinates, and where more than one rigid-body mode is excited. It is suggested that data qualification using this method would be a useful addition to most modal tests. A least squares approach, to determine the proper rigid-body response, is reviewed and several experimental examples are given. DOE

N88-18034# Sandia National Labs., Albuquerque, N. Mex.
FREQUENCY RESPONSE FUNCTION ESTIMATION AT LEVEL
R. Rodeman and N. T. Davie Dec. 1987 5 p Presented at the 6th International Modal Analysis Conference, Orlando, Fla., 1 Feb. 1988
(Contract DE-AC04-76DP-00789)
(DE88-002644; SAND-87-1619C; CONF-880220-6) Avail: NTIS HC A02/MF A01

A technique for determining structural frequency response functions at high excitation energy levels is described. The FRFs are obtained by firing long cylindrical bars into the structure of interest. The strain in the bar, which is easily measured, can be directly related to the force imparted to the structure. The FRFs are then obtained from relationships between the imparted force and the resulting accelerations in the structure. The method is simple to implement and the results obtained are repeatable. DOE

N88-18035*# Virginia Polytechnic Inst. and State Univ., Blacksburg. Dept. of Engineering Science and Mechanics.
OPTIMUM DESIGN OF GEODESICALLY STIFFENED COMPOSITE PLATES Progress Report
Zafer Guerdal and John L. Phillips 14 Mar. 1988 37 p
(Grant NAG1-643)
(NASA-CR-182499; NAS 1.26:182499) Avail: NTIS HC A03/MF A01 CSCL 20K

With the goal of tailorability in mind, the in-plane stiffness characteristics of a particular grid stiffened plate configuration under axial and shear loads have been studied. The contribution of the skin to the stiffener network and the resultant skin/rib interaction is analyzed. For the given plate geometry and loads, it is shown that an optimum configuration does exist. To achieve optimally designed practical plate configurations, buckling constraints need to be included in the design. Due to the complex geometry and loading of the plates, a simplified local buckling analysis of isolated stiffeners and triangular skin elements between the stiffeners is considered. Development of a stiffener buckling analysis represent stiffeners as shear deformable plate elements is presented. Author

N88-18036*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.
VIBRATION AND FLUTTER CHARACTERISTICS OF THE SR7L LARGE-SCALE PROPFAN
Richard August (Sverdrup Technology, Inc., Cleveland, Ohio.) and Krishna Rao V. Kaza Jan. 1988 22 p
(NASA-TM-100272; E-3908; NAS 1.15:100272) Avail: NTIS HC A03/MF A01 CSCL 20K

An investigation of the vibration characteristics and aeroelastic stability of the SR7L Large-Scale Advanced Propfan was performed using a finite element blade model and an improved aeroelasticity code. Analyses were conducted for different blade pitch angles, blade support conditions, number of blades, rotational speeds, and freestream Mach numbers. A finite element model of the blade was used to determine the blade's vibration behavior and sensitivity to support stiffness. The calculated frequencies and mode shape obtained with this model agreed well with the published experimental data. A computer code recently developed at NASA Lewis Research Center and based on three-dimensional, unsteady, lifting surface aerodynamic theory was used for the aeroelastic analysis to examine the blade's stability at a cruise condition of Mach 0.8 at 1700 rpm. The results showed that the blade is stable for that operating point. However, a flutter condition was

predicted if the cruise Mach number was increased to 0.9.
Author

N88-18037# Argonne National Lab., Ill.
ANALYSIS AND APPLICATION OF THE CONSTANT TENSILE LOAD TEST FOR POLYETHYLENE GAS PIPE MATERIALS
D. T. Raske May 1987 17 p Presented at the 10th Plastic Pipe Symposium, New Orleans, La., 27 Oct. 1987
(Contract W-31-109-eng-38)
(DE88-002868; CONF-8710220-1) Avail: NTIS HC A03/MF A01

This paper describes the development of analytical models for constant tensile load (CTL) test data obtained on commercial polyethylene (PE) gas pipe materials. The objective of this study was to assess and describe the mechanical behavior of PE gas pipe materials in support of a program to improve the long-term reliability and performance of these materials in fuel gas distribution systems. In order to provide a basis for identifying and quantifying the critical parameters in the manufacture of high-quality PE pipe, the analytical models must also be capable of accommodating and correlating chemical and molecular properties. This paper discusses the various models studied, provides comparisons with CTL test experiments, and considers the suitability of the CTL test as a quality assurance (QA) tool for use by gas utilities and PE gas pipe manufacturers in evaluating new pipe lots. DOE

N88-18038# Sandia National Labs., Albuquerque, N. Mex.
FATIGUE CRACK GROWTH DUE TO RANDOM LOADING
P. S. Veers Nov. 1987 163 p
(Contract DE-AC04-76DP-00789)
(DE88-004641; SAND-87-2039) Avail: NTIS HC A08/MF A01

Fatigue crack growth due to random loading is investigated, showing a variety of approaches that are tailored to the level of complexity required for the application at hand. The emphasis is on creating the simplest models, of both the crack growth process and the random loading, that maintain the desired level of accuracy. A new crack growth model, which combines some of the features of existing models, is introduced and shown to predict several sets of published test results. The model provides a means of approximating load sequence effects by continuously updating the crack opening stress, accounting for both acceleration and retardation effects in a simplified manner. This model is used as the standard crack growth model that includes sequence effects.
DOE

N88-18039# National Bureau of Standards, Gaithersburg, Md. Fracture and Deformation Div.
INSTITUTE FOR MATERIALS SCIENCE AND ENGINEERING, FRACTURE AND DEFORMATION DIVISION: TECHNICAL ACTIVITIES, 1987
1987 80 p
(PB88-153622; NBSIR-87/3613) Avail: NTIS HC A05/MF A01 CSCL 20K

The two major programs of the Fracture and Deformation Division of NBS are Elastic-Plastic Fracture Mechanics and Fracture Mechanisms and Analysis are summarized. Elastic-Plastic Fracture includes nondestructive evaluation, welding, and thermomechanical processing. Fracture Mechanisms and Analysis consists of physical properties, fracture physics, composite mechanics, cryogenic materials, and material performance. The principal accomplishments in these research areas, including wide plate crack arrest tests, a new model of plastic fracture, design and evaluation of a capacitance-array probe, measurement of the natural frequency for short-circuiting transfer in gas-metal-arc welding, and a model for prediction of the elastic properties of porous ceramics. Author

N88-18040*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.
RELATIONSHIP BETWEEN FATIGUE LIFE IN THE CREEP-FATIGUE REGION AND STRESS-STRAIN RESPONSE
A. Berkovits and S. Nadiv (Technion - Israel Inst. of Tech., Haifa.) 1988 21 p Proposed for presentation at the 6th International Congress on Experimental Mechanics, Portland, Oreg., 5-10 Jun. 1988; sponsored by the Society of Experimental Mechanics
(NASA-TM-100796; E-3972; NAS 1.15:100796) Avail: NTIS HC A03/MF A01 CSCL 20K

On the basis of mechanical tests and metallographic studies, strainrange partitioned lives were predicted by introducing stress-strain materials parameters into the Universal Slopes Equation. This was the result of correlating fatigue damage mechanisms and deformation mechanisms operating at elevated temperatures on the basis of observed mechanical and microstructural behavior. Correlation between high temperature fatigue and stress strain properties for nickel base superalloys and stainless steel substantiated the method. Parameters which must be evaluated for PP- and CC- life are the maximum stress achievable under entirely plastic and creep conditions respectively and corresponding inelastic strains, and the elastic modulus. For plasticity/creep interaction conditions (PC and CP) two more pairs of stress strain parameters must be ascertained. Author

N88-18041# Maryland Univ., College Park. Inst. for Physical Science and Technology
BENCHMARK COMPUTATION AND FINITE ELEMENT PERFORMANCE EVALUATION FOR A RHOMBIC PLATE BENDING PROBLEM Final Report
Ivo Babuska and Terenzio Scapolla Sep. 1987 46 p
(Contract N00014-85-K-0169)
(AD-A187402; BN-1068) Avail: NTIS HC A03/MF A01 CSCL 20K

The paper addresses the engineering benchmark computation of the bending rhombic plate. It shows the basic aspects and their influence on the performance of the finite element method.
GRA

N88-18042# Maryland Univ., College Park. Dept. of Electrical Engineering.
THE DYNAMICS OF COUPLED PLANAR RIGID BODIES. PART 1: REDUCTION, EQUILIBRIA AND STABILITY
N. Sreenath, Y. G. Oh, P. S. Krishnaprasad, and J. E. Marsden 30 Jul. 1987 40 p
(Grants AF AFOSR-0073-87; NSF OIR-85-00108)
(AD-A187467; AFOSR-87-1433TR-Pt-1) Avail: NTIS HC A03/MF A01 CSCL 20K

This paper studies the dynamics of coupled planar rigid bodies, concentrating on the case of two or three bodies coupled with a hinge joint. The Hamiltonian structure is non-canonical and is obtained using the methods of reduction, starting from canonical brackets on the cotangent bundle of the configuration space in material representation. The dynamics on the reduced space for two bodies occurs on cylinders in IR(3); stability of the equilibria is studied using the Energy-Casimir method and is confirmed numerically. The phase space of the two bodies contains a homoclinic orbit which produces chaotic solutions when the system is perturbed by a third body. This and a study of periodic orbits are discussed in part 2. The number and stability of equilibria and their bifurcations for three bodies as system parameters are varied are studied here; in particular, it is found that there are always 4 or 6 equilibria. GRA

N88-18043# Virginia Polytechnic Inst. and State Univ., Blacksburg. Dept. of Engineering Science and Mechanics.
THE ANALYSIS OF DEFORMATIONS AND STRAINS IN COMPOSITES BY MOIRE INTERFEROMETRY Final Report
Daniel Post Jul. 1987 11 p
(Contract N00014-86-K-0255)
(AD-A187482) Avail: NTIS HC A03/MF A01 CSCL 11D

Local deformation fields are exhibited for several composite members. Cases of severe shear strain gradients and local anomalies of material behavior are emphasized. Examples illustrated are from short beam tests, strain concentration analyses, multi ply panel tests and slotted metal-matrix tensile specimen tests. The experimental method, moire interferometry, yielded contour maps of in plane displacement fields with subwavelength

sensitivity, high fringe contrast and high spatial resolution are discussed. GRA

N88-18044# Naval Research Lab., Washington, D.C.
THE INFLUENCE OF SMALL DEFECTS ON TENSILE SPECIMEN DUCTILITY AND SYMMETRY OF DEFORMATION
Peter Matic and Mitchell I. Jolles 4 Sep. 1987 37 p
(AD-A187983; NRL-MR-5937) Avail: NTIS HC A03/MF A01 CSCL 20K

The quantitative translation of physical weld quality into structural integrity prediction depends on accurate characterization of weld material behavior in the presence of fabrication defects. The presence of such defects will, however, significantly influence the response of common material test specimens. If the influence of such defects is fully understood, test specimen data may be interpreted in a more meaningful way. The role of a physically relevant geometric imperfection, in the form of a spherical void defect, on cylindrical tensile specimen response is computationally simulated for HY-100 weld metal. Defect radius and location along the specimen axis are treated as independent parameters. Asymmetry of specimen deformation (in terms of specimen neck location) and specimen ductility (in terms of the reduction of area at failure) are computationally predicted. GRA

42 GEOSCIENCES (GENERAL)

No abstracts in this category.

43 EARTH RESOURCES AND REMOTE SENSING

Includes remote sensing of earth resources by aircraft and spacecraft; photogrammetry; and aerial photography.

For instrumentation see *35 Instrumentation and Photography.*

N88-18045# Naval Postgraduate School, Monterey, Calif.
NROSS (NAVY REMOTE OCEAN SENSING SYSTEM): A FORCE MULTIPLIER M.S. Thesis
Cheryl L. Spohnholtz Sep. 1987 79 p
(AD-A186853) Avail: NTIS HC A05/MF A01 CSCL 17H

This thesis examines the Navy Remote Ocean System (NROSS) as a force multiplier and shows why the Navy needs an oceanographic satellite. A history of oceanographic remote sensors provides background and is followed by a review of current and planned environmental satellites. The capabilities of these satellites are compared to Navy tactical requirements and deficiencies are noted. Finally, NROSS is discussed, and a look to the future shows why, more than ever, the Navy needs NROSS. GRA

N88-18046*# National Aeronautics and Space Administration, Washington, D.C.
SPACE-BASED REMOTE SENSING OF THE EARTH: A REPORT TO THE CONGRESS
Sep. 1987 147 p Original document contains color illustrations Prepared in cooperation with National Oceanic and Atmospheric Administration, Washington, D.C.
(NASA-TM-89709; NAS 1.15:89709) Avail: SOD HC $9.00 as 033-000-00983-6; NTIS MF A01 CSCL 08B

The commercialization of the LANDSAT Satellites, remote sensing research and development as applied to the Earth and its atmosphere as studied by NASA and NOAA is presented. Major gaps in the knowledge of the Earth and its atmosphere are identified and a series of space based measurement objectives are derived. The near-term space observations programs of the United States and other countries are detailed. The start is presented of the planning process to develop an integrated national program for research and development in Earth remote sensing for the remainder of this century and the many existing and proposed satellite and sensor systems that the program may include are described. Author

N88-18047# Utah Univ., Salt Lake City.
THREE-DIMENSIONAL TRANSIENT ELECTROMAGNETIC MODELING FOR EXPLORATION GEOPHYSICS Ph.D. Thesis
Gregory Alex Newman [1987] 242 p
Avail: Univ. Microfilms Order No. DA8722653

The three-dimensional (3-D) electromagnetic scattering problem is first formulated in the frequency domain in terms of an electric-field volume-integral equation. Three-dimensional responses are then Fourier-transformed with sine and cosine digital filters. The digital-filter technique is applied to a sparsely sampled frequency sounding, which is replaced by a cubic-spline interpolating function prior to convolution with the digital filters. A 3-D solution is used to study the galvanic response of a 3-D conductor energized by a large rectangular loop. In addition, the solution is applied to the central-loop sounding method for 3-D structural interpretation with layered-earth models and horizontal-field measurements. An integral-equation solution for the transient electromagnetic (TEM) scattering of prisms in layered half-spaces is formulated to provide meaningful results when the prisms are in highly resistive layers. The solution provides meaningful results over a wide range of layered-host resistivities, including that of free space. The solution is used to investigate the effect of conductive overburden on 3-D TEM responses and the lateral resolution of two conductors for the fixed-loop and central-loop configurations. Dissert. Abstr.

N88-18048# Geoexplorers International, Inc., Denver, Colo.
GEOLOGICAL EVOLUTION AND ANALYSIS OF CONFIRMED OR SUSPECTED GAS HYDRATE LOCALITIES. VOLUME 10: BASIN ANALYSIS, FORMATION AND STABILITY OF GAS HYDRATES OF THE ALEUTIAN TRENCH AND THE BERING SEA
J. Krason and M. Ciesnik Jan. 1987 183 p
(Contract DE-AC21-84MC-21181)
(DE88-001008; DOE/MC-21181/1950-Vol-10) Avail: NTIS HC A09/MF A01

Four major areas with inferred gas hydrates are the subject of this study. Two of these areas, the Navarin and the Norton Basins, are located within the Bering Sea shelf, whereas the remaining areas of the Atka Basin in the central Aleutian Trench system and the eastern Aleutian Trench represent a huge region of the Aleutian Trench-Arc system. All four areas are geologically diverse and complex. Particularly the structural features of the accretionary wedge north of the Aleutian Trench still remain the subjects of scientific debates. Prior to this study, suggested presence of the gas hydrates in the four areas was based on seismic evidence, i.e., presence of bottom simulating reflectors (BSRs). Although the disclosure of the BSRs is often difficult, particularly under the structural conditions of the Navarin and Norton basins, it can be concluded that the identified BSRs are mostly represented by relatively weak and discontinuous reflectors. Under thermal and pressure conditions favorable for gas hydrate formation, the relative scarcity of the BSRs can be attributed to insufficient gas supply to the potential gas hydrate zone. Hydrocarbon gas in sediment may have biogenic, thermogenic or mixed origin. In the four studied areas, basin analysis revealed limited biogenic hydrocarbon generation. The migration of the thermogenically derived gases is probably diminished considerably due to the widespread diagenetic processes in diatomaceous strata. The latter processes resulted in the formation of the diagenetic horizons. The identified gas hydrate-related BSRs seem to be located in the areas of increased biogenic methanogenesis and faults acting as the pathways for thermogenic hydrocarbons. DOE

N88-18049*# California Univ., Santa Barbara. Dept. of Geography.
IMPROVED CANOPY REFLECTANCE MODELING AND SCENE INFERENCE THROUGH IMPROVED UNDERSTANDING OF SCENE PATTERN Final Report
Janet Franklin and David Simonett 31 Jan. 1988 56 p
(Grant NGT-05-010-804)
(NASA-CR-182488; NAS 1.26:182488) Avail: NTIS HC A04/MF A01 CSCL 02F

The Li-Strahler reflectance model, driven by LANDSAT Thematic Mapper (TM) data, provided regional estimates of tree size and density within 20 percent of sampled values in two bioclimatic zones in West Africa. This model exploits tree geometry in an inversion technique to predict average tree size and density from reflectance data using a few simple parameters measured in the field (spatial pattern, shape, and size distribution of trees) and in the imagery (spectral signatures of scene components). Trees are treated as simply shaped objects, and multispectral reflectance of a pixel is assumed to be related only to the proportions of tree crown, shadow, and understory in the pixel. These, in turn, are a direct function of the number and size of trees, the solar illumination angle, and the spectral signatures of crown, shadow and understory. Given the variance in reflectance from pixel to pixel within a homogeneous area of woodland, caused by the variation in the number and size of trees, the model can be inverted to give estimates of average tree size and density. Because the inversion is sensitive to correct determination of component signatures, predictions are not accurate for small areas. Author

N88-18050# Geoexplorers International, Inc., Denver, Colo.
GEOLOGICAL EVOLUTION AND ANALYSIS OF CONFIRMED OR SUSPECTED GAS HYDRATE LOCALITIES. VOLUME 9: FORMATION AND STABILITY OF GAS HYDRATES OF THE MIDDLE AMERICA TRENCH
P. Finley and J. Krason Dec. 1986 261 p
(Contract DE-AC21-84MC-21181)
(DE88-001007; DOE/MC-21181/1950-Vol-9) Avail: NTIS HC A12/MF A01

This report presents a geological description of the Pacific margin of Mexico and Central America, including regional and local structural settings, geomorphology, geological history, stratigraphy, and physical properties. It provides the necessary regional and geological background for more in-depth research of the area. Detailed discussion of bottom simulating acoustic reflectors, sediment acoustic properties, and distribution of hydrates within the sediments are also included in this report. The formation and stabilization of gas hydrates in sediments are considered in terms of phase relations, nucleation, and crystallization constraints, gas solubility, pore fluid chemistry, inorganic diagenesis, and sediment organic content. Together with a depositional analysis of the area, this report gives a better understanding of the thermal evolution of the locality. It should lead to an assessment of the potential for both biogenic and thermogenic hydrocarbon generation. DOE

N88-18051* National Aeronautics and Space Administration, Washington, D.C.
EARTH RESOURCES: A CONTINUING BIBLIOGRAPHY WITH INDEXES (SUPPLEMENT 56)
Feb. 1988 151 p
(NASA-SP-7041(56); NAS 1.21:7041(56)) Avail: NTIS HC A07; NTIS standing order as PB88-903800, $15.50 domestic, $31.00 foreign CSCL 05B

This bibliography lists 547 reports, articles, and other documents introduced into the NASA scientific and technical information system between October 1 and December 31, 1987. Emphasis is placed on the use of remote sensing and geophysical instrumentation in spacecraft and aircraft to survey and inventory natural resources and urban areas. Subject matter is grouped according to agriculture and forestry, environmental changes and cultural resources, geodesy and cartography, geology and mineral resources, hydrology and water management, data processing and distribution systems, instrumentation and sensors, and economic analysis. Author

N88-18052# Oregon Graduate Center for Study and Research, Beaverton. Dept. of Applied Physics and Electrical Engineering.
REMOTE SENSING OF ATMOSPHERIC CROSSWINDS BY UTILIZING SPECKLE-TURBULENCE INTERACTION AND OPTICAL HETERODYNE DETECTION Final Report, 1 Jan. 1986 - 30 Jun. 1987
J. F. Holmes 16 Sep. 1987 33 p
(Contract DAAL03-86-K-0022)
(AD-A187580; ARO-23313.5-GS) Avail: NTIS HC A03/MF A01 CSCL 17K

Speckle-turbulence interaction can be utilized to measure the vector wind in a plane perpendicular to the line of sight from a laser transmitter to a target. A continuous wave source of around one watt and operating at 10.6 microns, in conjunction with an optical heterodyne receiver, has been used to measure atmospheric winds along horizontal paths. A theoretical basis, the experimental apparatus, processing techniques, and experimental results are presented. The technique has been demonstrated for remote sensing of atmospheric winds along horizontal paths and has potential for global remote sensing of atmospheric winds and for on-board wind shear detection systems for aircraft. GRA

N88-18053# Johns Hopkins Univ., Laurel, Md. Applied Physics Lab.
EVALUATION OF A TEMPERATURE REMOTE SENSING TECHNIQUE
S. A. Gearhart and M. E. Thomas Jul. 1987 29 p
(Contract N00039-87-C-5301)
(AD-A187885; JHU/APL/TG-1365) Avail: NTIS HC A03/MF A01 CSCL 14B

A noninvasive technique for measuring temperature in hot gases is evaluated as an alternative to conventional mechanical probing techniques. The technique uses a diode laser spectrometer to measure the line-center absorption coefficient ratio of two absorption lines that originate from different vibrational energy levels of the same absorbing species. The temperature is calculated without knowledge of the pressure, absorber concentration, or optical path length. A previous study demonstrated temperature measurements at about 200K at atmospheric pressure. The results of this evaluation suggest that the technique is also applicable for temperatures as low as 400 K and at pressures well below 1 atm. GRA

N88-18054# Nova Univ., Dania, Fla.
FIVE-DIAGONAL WEIGHTING SCHEME FOR GEOIDAL PROFILES
Georges Blaha Mar. 1987 21 p
(Contract F19628-86-K-0006)
(AD-A188033) Avail: NTIS HC A03/MF A01 CSCL 08E

Rigorous weighting of geoidal observations along profiles, such as encountered, for example, in satellite altimetry, would be a task exceedingly demanding in terms of computer run-time. A profile with m observation points would require an inversion of an (mxm) variance-covariance matrix, whose entries are correlated and depend almost entirely on the geoidal covariance function. However, if the observations are uniformly distributed, a slight modification of this function can greatly facilitate the formation of the weight matrix of observations, which subsequently enters the least-squares adjustment process. In the suggested method this matrix is five-diagonal. Its six distinct entries are known beforehand for any number of observations. GRA

N88-18055# Vexcell Corp., Boulder, Colo.
A SMART, MAPPING, CHARTING AND GEODESY CONTROL GENERATOR, PHASE 1 Final Report, Aug. 1986 - Mar. 1987
Franz Leberl, Woody Kober, and Mark Harjes Mar. 1987 72 p
(Contract DACA72-86-C-0008)
(AD-A188184; ETL-0458) Avail: NTIS HC A04/MF A01 CSCL 08B

The real-time automated registration of multi-sensor imagery begins with the generation of control information. A specific application may require the registration of newly acquired data to an existing spatial database (absolute registration), or to other images of a series (relative registration). This study examines the feasibility and upper-level design of a system capable of providing the control information required for a range of image registration tasks and image types. In general, the control generator we suggest will be guided by a spatial database maintaining information about the feature content of the area of interest. A rule based query generator will extract candidate ground control optimized for the particular image type and geometry at hand. GRA

N88-18056# Army Engineer Topographic Labs., Fort Belvoir, Va.
AUTOCORRELATION OF CONTROL POINTS ON 11-BAND MULTISPECTRAL IMAGERY
Robert S. Rand Aug. 1987 31 p
(AD-A188185; ETL-0473) Avail: NTIS HC A03/MF A01
CSCL 12I

The use of multispectral imagery with other types of imagery requires that the combined set be accurately registered. This study investigates correlation properties between bands of an 11-channel multispectral scanner for 37 control points in support of interband registration that can later be extended to dissimilar image registration. The results show a high degree of correlation between channels 1 through 7, but a lower and unpredictable correlation for other combinations. In addition to providing information about interband registration, the results also have implications for multispectral segmentation algorithms. GRA

N88-17699*# National Aeronautics and Space Administration. Langley Research Center, Hampton, Va.
PLANET X PROBE: A FRESH NEW LOOK AT AN OLD FAMILIAR PLACE
James Nicholson, Tom OBrien, Sharon Brower (Charleston County Public School District, S.C.), and Shelley Canright *In* NASA. Goddard Space Flight Center, The 1987 Get Away Special Experimenter's Symposium Feb. 1988 p 55-62 (For primary document see N88-17691 10-12)
Avail: NTIS HC A08/MF A01 CSCL 08B

N88-17701*# Herzberg Inst. of Astrophysics, Ottawa (Ontario).
THE PHOTONS PAYLOAD, G-494: A LEARNING EXPERIENCE
F. R. Harris, R. L. Gattinger, F. Creutzberg, and E. J. Llewellyn (Saskatchewan Univ., Saskatoon.) *In* NASA. Goddard Space Flight Center, The 1987 Get Away Special Experimenter's Symposium Feb. 1988 p 69-76 (For primary document see N88-17691 10-12)
Avail: NTIS HC A08/MF A01 CSCL 08B

44 ENERGY PRODUCTION AND CONVERSION

Includes specific energy conversion systems, e.g., fuel cells; global sources of energy; geophysical conversion; and windpower.

For related information see also *07 Aircraft Propulsion and Power, 20 Spacecraft Propulsion and Power,* and *28 Propellants and Fuels.*

N88-18057# Stanford Univ., Calif. Dept. of Chemistry.
ENERGY TRANSFER AND PHOTOCHEMISTRY IN BIOMIMETIC SOLAR CONVERSION Annual Report, Oct. 1986 - Sep. 1987
S. G. Boxer Sep. 1987 16 p
(Contract GRI-5083-260-0824)
(PB88-130026; GRI-87/0261) Avail: NTIS HC A03/MF A01
CSCL 10A

Electron transfer is being studied in several well-defined molecular systems, and techniques for studying electron transfer are being developed. Photo-induced electron transfer lies at the heart of photosynthesis and forms the basis for the approach to biomimetic solar conversion. Electron donors and acceptors are covalently connected to molecular frameworks which permit variation of the distance between sites and the nature of the intervening medium. Myoglobin produced by recombinant DNA methods was modified to place a free sulfhydryl group at various positions on the surface for attachment of electron acceptors. Surface histidine residues are modified with Ru-reagents. Electron donors and acceptors were also attached to double-helical DNA as a first approach to polymer-based donor/acceptor systems. The effects of applied electric fields on the absorption and emission spectra of compounds undergoing electron transfer were studied. The Stark effect spectra of several Ru-complexes were obtained, from which quantitative information on changes in the permanent dipole moment between the ground and the excited state was extracted. It was also shown that, under certain conditions, the electric field can change the rate of electron transfer reactions, and that the effect is easily detected in the electric-field-modulated fluorescence spectrum. These effects were demonstrated for bacterial reaction centers and certain Ru-complexes. GRA

N88-18058# Energy Research Corp., Danbury, Conn.
DETERMINATION OF OPTIMUM ELECTROLYTE COMPOSITION FOR MOLTEN CARBONATE FUEL CELLS LITERATURE REVIEW
C. Y. Yuh and A. Pigeaud Apr. 1987 63 p
(Contract DE-AC21-86MC-23264)
(DE88-001015; DOE/MC-23264/2507) Avail: NTIS HC A04/MF A01

Our review of the earlier cell testing data suggests that a more conductive electrolyte may improve total cell performance, primarily as a result of reduction of IR-loss in the electrolyte tile or matrix. This IR loss contributes significantly to cell performance loss. However, electrode performances could not be correlated very well with either potassium content or electrolyte conductivity, primarily due to possible off-setting effects in cathode kinetics, mass transfer, and ohmic resistance inside this porous electrode. The cell data discussed above concerned only short-term results and thus only the effects on performance were studied. The problems affecting endurance, e.g., corrosion, NiO dissolution, and matrix support stability could not be analyzed in these tests. This review therefore indicated that optimization of electrolyte composition is potentially available and could be beneficial to arrive at an optimum combination of performance/endurance and cost factors. Further systematic and careful experimental work will be necessary while emphasizing the need for repeatability and long-term stable and representative conditions. DOE

N88-18059# Department of Energy, Portland, Oreg.
CAPE BLANCO WIND FARM FEASIBILITY STUDY Final Report
Nov. 1987 209 p Prepared in cooperation with Portland General Electric Co., Oreg.; Pacific Power and Light Co., Portland, Oreg. and Windfarms Northwest, Oreg.
(Contract DE-AC79-83BP-11191)
(DE88-003748; DOE/BP-11191/14) Avail: NTIS HC A10/MF A01

The Cape Blanco Wind Farm (CBWF) Feasibility Study was undertaken as a prototype for determining the feasibility of proposals for wind energy projects at Northwest sites. It was intended to test for conditions under which wind generation of electricity could be commercially feasible, not by another abstract survey of alternative technologies, but rather through a site-specific, machine-specific analysis of one proposal. Some of the study findings would be most pertinent to the Cape Blanco site - local problems require local solutions. Other findings would be readily applicable to other sites and other machines, and study methodologies would be designed to be modified for appraisal of other proposals. This volume discusses environmental, economic, and technical issues of the Wind Farm. DOE

N88-18060# Department of Energy, Portland, Oreg. Power Administration.
CAPE BLANCO WIND FARM FEASIBILITY STUDY Summary Report, 1987
Nov. 1987 38 p
(Contract DE-AC79-83BP-11191)
(DE88-003749; DOE/BP-11191/13) Avail: NTIS HC A03/MF A01

The Cape Blanco Wind Farm Feasibility Study investigated the engineering, economic, environmental and meteorological aspects of a proposed 80 MW wind energy project on a 1600-acre site southeast of Cape Blanco, Oregon. Study sponsors evaluated the potential impacts of large (2500 kW) MOD-2 and intermediate (170 kW) FloWind turbines. This volume is a summary of the study and its conclusions. DOE

N88-18061# Societe Bertin et Cie, Plaisir (France). Div. Energetique.
ANALYSIS OF THE PERFORMANCE OF AN AIR-WATER HEAT PUMP: REGULATION OF INTRINSIC PERFORMANCES Final Report
H. Martin-Neuville, M. Reybillet, and J. P. Patureau 1986 141 p In FRENCH
(DE88-900241; EUR-10523) Avail: NTIS (US Sales Only) HC A07

Improvements for an electrical compressor heat pump of around 12 kW with air as a heat source are examined. To test the heat pump under different weather conditions a test loop has been built. On the condenser side a water circuit with several capacities and heat exchangers simulates the thermal behavior of a 120 sq m dwelling. A commercial domestic heat pump was extensively tested. The instantaneous performance of the heat pump agreed well with the data claimed by the manufacturer. The annual energy saving, however, was significantly less due to the following: (1) loss of efficiency caused by defrosting cycles; (2) loss of efficiency due to inadequate thermal load matching between the heat pump and the house. It was shown that control of the condensing temperature can bring energy savings of 10 percent. This could probably also be realized by load matching with a compressor with a variable speed; and (3) the inefficient operation of components such as the evaporator and the condenser heat exchangers and the expansion valve. Optimization could lead to a considerable improvement. Modifications in the compressor are proposed which may lead to an increase in efficiency to 60 or 70 percent. DOE

N88-18062# National Aerospace Lab., Tokyo (Japan).
STUDY ON A ROTOR SPEED CONTROL SYSTEM FOR A HORIZONTAL AXIS WINDMILL
Masataka Hashidate, Asao Hanzawa, Shoichi Murota, and Masayoshi Noguchi 1987 45 p In JAPANESE; ENGLISH summary
(NAL-TR-931; ISSN-0389-4010) Avail: NTIS HC A03/MF A01

Rotor speed control technology in windmills is indispensable not only in attaining a high level of energy conversion but also in avoiding damage to the windmill rotor system under very strong wind conditions. This study was conducted as part of the component technology research and development program for the 20kw horizontal axis windmill system development project sponsored by the Science and Technology Agency of Japan. A hydraulic pitch control system for a 1kw class windmill (a pioneering subscale model for the 20kw windmill) was developed and improved through repeated tests in the NAL low speed wind tunnel and in field tests. The original application of the electromagnetic proportional hydro-relief valve to the hydraulic pitch control system of windmills brought an outstanding reduction of the variation in widnmill rotational speed. Test results confirm the excellent characteristics of the windmill rotor speed control. The practicality of the hydraulic pitch control system has been proving itself in the 20kw windmill operation since December 1985. Author

N88-18063# Fayette Mfg. Corp., Tracy, Calif.
WAKE EFFECTS IN A FAYETTE 95-IIS WIND TURBINE ARRAY
R. L. Simon, D. F. Matson, and J. M. Fuchs Sep. 1987 75 p Prepared in cooperation with Midwest Research Inst., Golden, Colo.
(Contract DE-AC02-83CH-10093)
(DE88-001103; SERI/STR-217-3186) Avail: NTIS HC A04/MF A01

A group of 35 wind turbines on the Castello Ranch in Altamont Pass, California, was investigated to quantify array wake effects (losses in energy production due to operation of upwind turbines) and the factors influencing them. Approximately 65 hours of field measurements were made in summer 1986, with turbine energy production and wind velocity data recorded for various scenarios of array operation. Customized software and hardware were developed and installed by Fayette to facilitate these measurements. The existence of wake effects was fairly well established. Relative energy-production losses averaged 6 percent at the second row, when the first row was operating, and 7 to 8 percent at the third row, when the first two were operating. Apparently, then, the impact of the first row on the third (at a 21-rotor-diameter distance) was minimal. Ambient wind speed did not appear to affect the relative wind speed pattern within the array due to wakes, but because of the shape of the performance curve, it did affect relative energy production losses (particularly for the low-RPM mode of machine operation). The influences of ambient atmospheric conditions, such as stability, turbulence, and shear on the array wakes, were also investigated by testing over a range of the conditions available during a typical 24-hour day at the test site. None of these variables showed any significant effect on the degree of wake-induced energy losses. While the results of this study apply only to this specific array and type of wind turbine, the methodology could be applied to study wake effects at other wind farms. DOE

N88-18064# Argonne National Lab., Ill.
LABORATORY EVALUATION AND ANALYSIS OF ADVANCED LEAD-ACID LOAD-LEVELING BATTERIES
J. F. Miller, T. P. Mulcahey, C. C. Christianson, J. J. Marr, and J. A. Smaga 1987 16 p Presented at the International Conference on Batteries for Utility Energy Storage, West Berlin, Fed. Republic of Germany, 8 Nov. 1987
(Contract W-31-109-eng-38)
(DE88-002851; CONF-871194-1) Avail: NTIS HC A03/MF A01

Argonne National Laboratory has conducted an extensive evaluation of advanced lead-acid batteries developed by the Exide Corporation for load-leveling applications. This paper presents the results of performance and accelerated life tests conducted on these batteries over a five-year period. This paper describes the operational reliability and maintenance requirements for this technology, and also includes analyses of the batteries' thermal characteristics, arsine/stibine emission rates, and cell degradation modes as determined from post-test examinations. DOE

N88-18065# Syracuse Univ., N. Y. Dept. of Chemistry.
PHOTOCHEMICAL SOLAR ENERGY CONVERSION UTILIZING SEMICONDUCTORS LOCALIZED IN MEMBRANE MIMETIC SYSTEMS
J. H. Fendler 1987 6 p Presented at the 11th DOE Solar Photochemistry Research Conference, Tahoe City, Calif. 7 Jun. 1987
(Contract DE-FG02-86ER-13506)
(DE88-002887; DOE/ER-13506/3; CONF-870666-2) Avail: NTIS HC A02/MF A01

Synthetic surfactant vesicles, polymerized vesicles, and bilayer lipid membranes (BLMs) are the membrane mimetic systems which compartmentalize the catalyst-coated microcrystalline semiconductors and sacrificial electron donors. BLM-incorporated semiconductors allow the simultaneous spectroscopic and electrical monitoring of photoelectron transfers on and across ultrathin membranes. Quantum size effects have been established in the generation of CdS particles in dioctadecyl dimethyl ammonium

chloride (DODAC) surfactant vesicles. Depending on the method of preparation and the stoichiometrical amounts of H2S added, CdS semiconductor absorption edges were found to range from 478 to 385 nm, corresponding to particle diameter variations between greater than 50 and 22 A. Surfactant vesicles provide differential sites for CdS formation, shift the equilibrium between nucleation and particle growth toward the former, stabilize the growing particles along with the anions present (Cl(-), OH(-), EDTA2(-), and SH(-), and, most importantly, allow a convenient control of particle sizes and size distributions. The smallest sized CdS particles with the narrowest size distribution were obtianed in preparation A. Importantly, smaller sized DODAC-vesicle-entrapped CdS particles were shown to undergo more efficient, photosensitized electron transfer to methylviologen than larger ones. DOE

N88-18066# Sandia National Labs., Albuquerque, N. Mex.
MODAL TESTING THE EOLE
T. G. Carne, J. P. Lauffer, and A. J. Gomez 1987 8 p Presented at the 7th Wind Energy Symposium, New Orleans, La., 10 Jan. 1988 Prepared in cooperation with Shawinigan Engineering Co. Ltd., Montreal, Quebec
(Contract DE-AC04-76DP-00789)
(DE88-003795; SAND-87-1506C; CONF-880132-5) Avail: NTIS HC A02

Modal testing an immense and flexible wind turbine poses a number of problems. It requires innovative excitation techniques since the modal frequencies of this type of structure are quite low. Also, substantial energy must be input to the structure to obtain reasonable levels of response. In this paper, the results of the modal test of the 110 m tall EOLE wind turbine are presented which had a number of modal frequencies below 1.0 Hz. Step-relaxation and wind were used to excite the structure. DOE

N88-18067# Helsinki Univ. Technology, Otaniemi (Finland). Dept. of Technical Physics.
EFFECT OF STORAGE THERMAL BEHAVIOR IN SEASONAL STORAGE SOLAR HEATING SYSTEMS
P. D. Lund 16 Dec. 1986 44 p
(PB88-114236; TKK-F-A604; ISBN-951-753-978-9) Avail: NTIS HC A03/MF A01 CSCL 10A

An analytical methodology has been developed to investigate the effects of storage operational strategies (or, equivalently, stratification) on the performance of a seasonal storage solar heating system with a constructed water volume. The method is based on a relative comparison between a thermally stratified and well-mixed storage system representing probable extreme outcomes of the subsystem-to-storage loop control strategies. The effects are described in the form of performance reduction factors that describe maximum changes in the solar collector yield, storage losses, and solar fraction due to storage operational mode. The study indicates that the storage thermal behavior could in the worst case affect the yearly solar fraction by a factor of 1.8, but most likely a maximum value from 1.1 to 1.5 could be expected. GRA

N88-18068*# Harris Corp., Melbourne, Fla. Government Aerospace Systems Div.
SOLAR CONCENTRATOR ADVANCED DEVELOPMENT PROGRAM, TASK 1 Final Report
Jun. 1986 223 p
(Contract NAS3-24670)
(NASA-CR-179489; NAS 1.26:179489) Avail: NTIS HC A10/MF A01 CSCL 10A

Solar dynamic power generation has been selected by NASA to provide power for the space station. Solar dynamic concentrator technology has been demonstrated for terrestrial applications but has not been developed for space applications. The object of the Solar Concentrator Advanced Development program is to develop the technology of solar concentrators which would be used on the space station. The first task of this program was to develop conceptual concentrator designs and perform trade-off studies and to develop a materials data base and perform material selection. Three unique concentrator concepts; Truss Hex, Spline Radial Panel and Domed Fresnel, were developed and evaluated against weighted trade criteria. The Truss Hex concept was recommended for the space station. Materials data base development demonstrated that several material systems are capable of withstanding extended periods of atomic oxygen exposure without undesirable performance degradation. Descriptions of the conceptual designs and materials test data are included. Author

N88-18069# Midwest Research Inst., Golden, Colo. Solar Energy Research Inst.
EXPERIMENTAL STUDIES OF HEAT AND MASS EXCHANGE IN PARALLEL-PASSAGE ROTARY DESICCANT DEHUMIDIFIERS FOR SOLAR COOLING APPLICATIONS
D. Bharathan, J. M. Parsons, and I. L. Maclaine-cross Nov. 1987 102 p
(Contract DE-AC02-83CH-10093)
(DE88-001119; SERI/TR-252-2897) Avail: NTIS HC A06/MF A01

This report presents results of work done to experimentally characterize the performance of rotary desiccant dehumidifiers and to develop and validate analytical methods for evaluating their performance in air-conditioning systems. A facility, the Cyclic Test Facility, and a test-and-analysis procedure were developed to evaluate the performance of the rotary dehumidifiers. Experiments were performed to develop a basic understanding of the simultaneous heat- and mass-transfer processes in the dehumidifiers. Two test articles were tested under cyclic operation to characterize their performance. Detailed accounts of the Cyclic Test Facility, its hardware and instrumentation, the two test articles, and data reduction and analysis methods are provided. The data provide an engineering data base for evaluating rotary desiccant dehumidifiers for cooling applications. DOE

N88-18070# Midwest Research Inst., Golden, Colo. Solar Energy Research Inst.
PRELIMINARY RESULTS FROM THE DYNAMIC RESPONSE TESTING OF THE WESTINGHOUSE 600-kW WIND TURBINE
T. E. Hausfeld, S. M. Hock, and R. W. Thresher Dec. 1987 9 p Presented at the Windpower '87, San Francisco, Calif., 5 Oct. 1987
(Contract DE-AC02-83CH-10093)
(DE88-001123; SERI/TP-217-3276; CONF-871062-10) Avail: NTIS HC A02/MF A01

This paper provides a preliminary look at test data from a Westinghouse 600-kW wind turbine. The Westinghouse machine was fitted with instrumentation to record machine data, as well as wind and atmospheric conditions. Wind data were collected from five levels of anemometers mounted on a meteorological tower upwind of the turbine. Because of problems encountered while digitizing the data, this paper presents results from a very limited number of channels and time-series data segments. Three sets of 10-minute data segments are presented that cover power, pitch angle, and blade loads. Because of the narrow scope of this analysis, the following conclusions should be considered tentative: (1) Energy production appears to be somewhat better than predicted. (2) The teetering hub appears to be operating as expected, and the rotor is teetering to eliminate much of the loading caused by the mean wind shear in the inflow. (3) A large part of the flapping-moment variation is caused by low-frequency turbulence in the inflow. DOE

N88-18071# Pacific Northwest Labs., Richland, Wash.
ADVANCED MATERIALS FOR SOLID OXIDE FUEL CELLS
C. W. Griffin and J. L. Bates 1987 21 p Presented at the Fossil Energy Materials Program Conference, Oak Ridge, Tenn., 19 May 1987
(Contract DE-AC06-76RL-01830)
(DE88-002338; PNL-SA-14931; CONF-8705103-13) Avail: NTIS HC A03/MF A01

Materials based on the In sub 2 O sub 3- PrO sub 1.83- ZrO sub 2 system were examined as potential electrodes and current interconnects for solid oxide fuel cells (SOFC). The electrical

transport, thermal, and electrochemical properties are described in relationship to structure, phase equilibria, and composition. The electrical conductivity was dependent on structure and composition, and can exceed the conductivity of the state-of-the-art electrode/interconnect materials. The instability of the In sub 2 O sub 3 reducing environments may eliminate this system as SOFC anodes or interconnects. This system may be used as cathodes if indium does not diffuse into the electrolyte and degrade fuel cell performance. DOE

N88-18072# Sandia National Labs., Albuquerque, N. Mex.
MODAL TESTING OF A VERY FLEXIBLE 110 m WIND TURBINE STRUCTURE
T. G. Carne, J. P. Lauffer, A. J. Gomez, and Hassine Benjannet 1988 8 p Presented at the 6th International Modal Analysis Conference, Orlando, Fla., 1 Feb. 1988 Prepared in cooperation with Shawinigan Engineering Co. Ltd., Montreal, Quebec
(Contract DE-AC04-76DP-00789)
(DE88-003796; SAND-87-1507C; CONF-880220-9) Avail: NTIS HC A02

Modal Testing of immense and very flexible structures poses a number of problems. It requires innovative excitation techniques since the modal frequencies of these stuctures can be quite low. Also, substantial energy must be input to the structure to obtain reasonable levels of response. In this paper, results are presented from a modal test of the 110 m tall EOLE wind turbine which had four modal frequencies below 1.0 Hz. Step-relaxation and wind were used to excite the structure. DOE

N88-18073# Argonne National Lab., Ill.
SIDE-BY-SIDE COMPARISONS OF EVACUATED COMPOUND PARABOLIC CONCENTRATOR AND FLAT PLATE SOLAR COLLECTOR SYSTEMS AT TEMPERATURES OF 90 TO 100C
J. W. Allen, W. W. Schertz, and A. S. Wantroba Mar. 1987 23 p
(Contract W-31-109-eng-38)
(DE88-004717; ANL/CNSV-TM-191) Avail: NTIS HC A03/MF A01

This collector system study is an extension of a previous system study in which Argonne National Laboratory (ANL) compared the performance of three solar energy systems operated side by side for over a year. In the present system study, four solar energy systems were operated side by side for part of a year. Two of the collector systems used commercially available compound parabolic concentrator (CPC) collectors, one used a commercially available flat plate collector, and one used an experimental CPC collector built by The University of Chicago. The collectors were mounted in fixed positions; they did not track the Sun, and their tilt angles were not seasonally adjusted. All of the collector arrays faced south and were tilted at 42 deg with respect to the horizon (to match the 42 deg N latitude at ANL). All four collector systems started each day with their storage temperatures at 90 C. During the day, each system was operated by its own solar controller. At the end of the day, the tanks were mixed and the temperature changes in the tanks were measured. The change in storage energy was calculated from the temperature change, the heat capacity of the storage system, and the pump energy. DOE

N88-18074# Sandia National Labs., Albuquerque, N. Mex.
ANALYSIS OF WIND TURBINES ON OFFSHORE SUPPORT STRUCTURES EXCITED BY RANDOM WIND AND RANDOM WAVES
D. S. Oscar and T. L. Paez Jan. 1988 24 p
(Contract DE-AC04-76DP-00789)
(DE88-004772; SAND-87-1689) Avail: NTIS HC A03/MF A01

A numerical approach has been developed to predict the dynamic response of structures excited by random wind and random waves, such as wind turbines at offshore locations. The software developed by this effort, called OFFSHORE HAWTDYN, calculates the displacement time response of horizontal axis wind turbines (HAWTs) attached to offshore support structures subjected to steady and random wind and wave forces that simulate ocean environments. This software utilizes the structural dynamic analysis capability of HAWTDYN, a code developed at Sandia National Laboratories, to solve the equations of motion. The HAWTDYN code was modified to permit the application of water wave loads to the structure being analyzed. DOE

N88-18075# Midwest Research Inst., Golden, Colo. Solar Energy Research Inst.
TURBULENCE LOADS ON THE HOWDEN 26-m-DIAMETER WIND TURBINE
P. H. Madsen, S. M. Hock, and T. E. Hausfeld Nov. 1987 12 p Presented at the 7th Wind Energy Symposium, New Orleans, La., 10 Jan. 1988
(Contract DE-AC02-83CH-10093)
(TI88-001118; SERI/TP-217-3269; CONF-880132-4) Avail: NTIS HC A03

Conducted in Palm Springs, California, a joint effort between SERI and James Howden and Company involved a comprehensive test program on the 330-kW Howden wind turbine with a three-bladed, fixed-hub rotor 26 m in diameter. Part of the measurement analysis is to quantify the turbulence loads during the steady-state production modes of operation. Assuming wind turbulence to be the cause of the random loads, the turbulence loads in terms of blade root-bending moments have been determined empirically by isolating the random or nonperiodic part of the load signals using azimuthal averaging. Standard deviations as functions of wind speed, as well as power spectra of the loads, are presented. The measured turbulence loads are compared to a recently developed model for turbulence loading of wind turbines. The model works in the frequency domain and uses the standard engineering representation of turbulence in terms of a coherence function and a wind-power spectrum at a fixed point in space. The turbulence load model accounts for the dominant mode of vibration for the load in question and is intended to be simple enough to be used for a preliminary load estimate for practical design purposes. DOE

N88-18076# Department of Energy, Washington, D. C. Office of Fossil Energy.
THE ROLE OF REPOWERING IN AMERICA'S POWER GENERATION FUTURE
Dec. 1987 45 p
(DOE/FE-0096) Avail: NTIS HC A03/MF A01

Repowering--modifying aging coalfired electric power generating units with a new generation of environmentally clean, highly efficient coal technologies--can lead to long-term, sustained emission reductions, higher energy efficiencies, and more economical electricity for consumers. If the repowering design includes a combined cycle configuration, the potential exists to satisfy much of the nation's foreseeable demand for new capacity without undertaking expensive new power plant construction. This report analyzes the potential benefits of repowering with advanced, innovative clean coal technologies. It approaches the repowering option from the perspective of utility decisionmaking. Beneficial effects with respect to atmospheric pollution, in particular SO2 reduction and resulting acid rain reduction, are discussed.
Author

N88-18077# Minnesota Univ., Minneapolis. Dept. of Mechanical Engineering.
A SOLAR RECEIVER-REACTOR WITH SPECULARLY REFLECTING WALLS FOR HIGH-TEMPERATURE THERMOELECTROCHEMICAL AND THERMOCHEMICAL PROCESSES
A. Steinfeld and Edward A. Fletcher 27 Oct. 1987 39 p
(Contract N00014-82-K-0523)
(AD-A187612; TR-11) Avail: NTIS HC A03/MF A01 CSCL 10B

A new kind of receiver-reactor for high temperature solar furnaces is proposed. The main body of the receiver component is an ellipsoid of revolution with specularly reflecting inner walls. The reactor component, a crucible, is placed at one focal point and the aperture at the other. With this arrangement, substantially

all of the incident radiation from the concentrator should reach the reactor directly or after one reflection from the cavity walls. An analysis of the radiative exchange among the surfaces is presented. The analysis provides a tool for a parametric study and optimization of the design. It is found that, in contrast to that of conventional well-insulated cavity receivers, its collection efficiency is not very sensitive to the size of its aperture. GRA

N88-18078# Rockwell International Corp., Anaheim, Calif. Science Center.
ELECTROCHROMIC CELLS WITH LUTETIUM DIPHTHALOCYANINE AND SEMISOLID POLYMER ELECTROLYTES Technical Report, 1 Jan. 1985 - 31 Aug. 1987
F. A. Pizzarello and M. M. Nicholson Nov. 1987 16 p
(Contract N00014-77-C-0630)
(AD-A188031; SC5384.TR) Avail: NTIS HC A03/MF A01 CSCL 07F

Cyclic voltammograms were obtained for lutetium diphthalocyanine films in contact with plasticized poly(ethylene oxide) (PEO) electrolytes or solvent-swollen 2-acrylamido-2-methylpropane- sulfonic acid (AMPS) polymer electrolytes. Cells containing PEO-salt combinations plasticized with propylene glycol (PG) or acetonitrile resulted in slow, nonuniform color changes due to high interfacial resistance. The AMPS cell fabrication was simplified by starting with a commercial AMPS polymer product in the form of a transparent sheet containing water and other additives. This material, when further swollen in a PG-HC1 solution, produced the full range of uniform colors, accompanied by well defined voltamograms. It maintained good contact with the dye from -5 to 40 C. GRA

45 ENVIRONMENT POLLUTION

Includes atmospheric, noise, thermal, and water pollution.

N88-18079# National Oceanic and Atmospheric Administration, Silver Spring, Md. Air Resources Lab.
METEOROLOGICAL AND AEROSOL MEASUREMENTS FROM THE NOAA WP-3D AIRCRAFT DURING WATOX-86, JANUARY 4-9, 1986
H. Bridgman, B. Stunder, R. Artz, G. Rolph, and R. Schnell Jul. 1987 76 p Prepared in cooperation with Colorado Univ., Boulder
(PB88-120860; NOAA-TM-ERL-ARL-156) Avail: NTIS HC A05/MF A01 CSCL 13B

On January 4, 6, 8, and 9, 1986, NOAA WP-3D research flights were conducted over the Western Atlantic Ocean, two to three hundred km off the coast of North America. Flights were made perpendicular to NW airflow to establish the flux of gas and aerosol emissions from the east coast of North America. The following data is presented for each flight: a horizontal projection of the flight track on a latitude-longitude grid; the relevant synoptic situation; air-parcel back-trajectories; a flight log; vertical cross sections of condensation nuclei (CN) and aerosol scattering extinction (b sub sp); and representative aerosol size distributions. GRA

N88-18080# Pacific Northwest Labs., Richland, Wash.
EVALUATION OF REGIONAL-SCALE AIR QUALITY MODELS: CHAIRMEN REPORTS FROM FOUR WORKSHOPS Final Report
W. R. Barchet, ed. Oct. 1987 161 p Operational Evaluation Network Workshop, Seattle, Wash., 19 Nov. 1985; Model Evaluation Protocols Workshop, Raleigh, N.C., 11 Feb. 1986; Field Study Design Workshop, Seattle, Wash., 11 Mar. 1986; Quality Assurance Workshop, Toronto, 11 Jun. 1986
(Contract DE-AC06-76RL-01830; EPRQ Proj. 1630-40)
(DE88-001397; EPRI-EA-5473) Avail: NTIS HC A08/MF A01

Regional acid deposition models are to be scientifically defensible tools for analyzing the consequences of proposed emissions control policies for acid deposition abatement. Complete chairman's reports for the four workshops are presented in this document. This first produced a technical plan for the Operational Evaluation Network (OEN). Criteria for site selection are given. Measurement requirements and sampling and analytical procedures are specified. The second workshop dealt with the need for model evaluation protocols. Additional measurement needs, crucial to model evaluation, were defined. Vertical profiles of ambient concentrations and meteorological conditions were recommended to provide the third dimension for model evaluation. Specific studies that focus on the evaluation of individual modules within the comprehensive models were also defined. In the third workshop working definitions of terms associated with the model evaluation program were codified. Comparison of the spatial and temporal resolution of modeled and observed quantities led to recommendations on how the field programs are to obtain the data. The fourth workshop focused on quality assurance and data archival for model evaluation field studies. The workshop provided a set of guidelines and objectives to be used to design and implement a quality assurance program for these tasks. Guidelines for data management and archival were formulated. These included provisions for data distribution, documentation, and archival. Chapters are processed separately for the data base. DOE

N88-18081# Wisconsin Univ., Madison.
PHYSIOLOGICAL AND ECOLOGICAL IMPLICATIONS OF COUPLED HEAT- AND WATER-TRANSPORT MECHANISMS OF ENDOTHERMS AND VEGETATION Progress Report, 1 Jul. 1986 - 31 Jan. 1987
W. P. Porter and W. E. Stewart Feb. 1987 11 p
(Contract DE-FG02-84ER-60264)
(DE88-004170; DOE/ER-60264/T1) Avail: NTIS HC A03

Current quantitative general heat- and mass-transfer model for porous insulation (FUR) of endotherms is described along with the performance of the model in predicting the heat-generation requirements and water-loss rates for different insulations under conditions measured in the laboratory and in the field. The mechanistic model for endotherms will ultimately provide an enhanced means for generating and testing ecological hypotheses, such as environmental effects on herbivory rates, growth and reproduction rates, survival probabilities and population dynamics. The responses of endotherms to environmental contaminants could also be assessed. We have linked individual physical and physiological properties directly to population dynamics models. We have also begun to incorporate stochastic processes into the models to deal with uncertainty in environments and animal physiological properties. DOE

N88-18082# California Univ., Berkeley. Lawrence Berkeley Lab.
THE ROLE OF ANALYTICAL CHEMISTRY IN ASSESSING ATMOSPHERIC EFFECTS OF COMBUSTION
T. Novakov Sep. 1987 52 p Presented at the EUROANALYSIS VI: European Conference on Analytical Chemistry, Paris, France, 7 Sep. 1987
(Contract DE-AC03-76SF-00098)
(DE88-003909; LBL-22724; CONF-870954-1) Avail: NTIS HC A04/MF A01

This paper discusses sampling and analysis strategies designed to distinguish local and regional sulfate and to identify heterogeneous SO sub 2 oxidation in an urban heavily polluted atmosphere. The role of analytical chemistry will be illustrated by reviewing the results of a multi-year international cooperative study conducted principally in Ljubljana, Yugoslavia. The analytical results, when combined with physical measurements and meteorological data, have enabled us to assess the role of combustion effluent in SO sub 2 oxidation and to infer the interrelationship between the chemical and physical properties of the atmosphere. The conclusions from field measurements about the SO sub 2 oxidation process were verified by laboratory cloud chamber experiments designed to simulate the conditions encountered in a source-dominated atmosphere. DOE

N88-18083*# Jet Propulsion Lab., California Inst. of Tech., Pasadena.
ENVIRONMENTAL PROJECTS. VOLUME 4: ASBESTOS SURVEY
L. Kushner (Gilbert, M. B. Associates, Long Beach, Calif.) 1 Feb. 1988 414 p
(Contract NAS7-918)
(NASA-CR-182527; JPL-Publ-87-4-Vol-4; NAS 1.26:182527)
Avail: NTIS HC A18/MF A01 CSCL 13B

The Goldstone Deep Space Communications Complex (GDSCC), near Barstow, California, operates in support of six large parabolic dish antennas. Many of the buildings and structures at the GDSCC were erected before it became known that asbestos posed a hazard to human health. Thus, because of concern with asbestos, two field surveys were conducted at the GDSCC in October/November 1986 and in September 1987 to locate, classify, and quantify all asbestos-containing materials in buildings, structures, roofs and boilers. The report describes the results of the two surveys and describes methods for both asbestos management and asbestos abatement. The surveys found that GDSCC practices involving asbestos are conscientious and forward-thinking. A program, due to start in FY 1988 and to be completed in FY 1990, is planned to remove all friable (easily pulverized) asbestos-containing materials discovered during the two field surveys for asbestos at the GDSCC. Author

46 GEOPHYSICS

Includes aeronomy; upper and lower atmosphere studies; ionospheric and magnetospheric physics; and geomagnetism.

For space radiation see *93 Space Radiation.*

N88-18084*# National Aeronautics and Space Administration, Washington, D.C.
INTO THE THERMOSPHERE: THE ATMOSPHERE EXPLORERS
Eric Burgess and Douglass Torr 1987 172 p Original document contains color illustrations
(NASA-SP-490; NAS 1.21:490; LC-87-14156) Avail: SOD HC $14.00 as 033-000-01013-3; NTIS MF A01 CSCL 04A

The need to study the lower thermosphere with the new instrument, data handling, and spacecraft technology available in the 1960s led to the formulation and establishment of the Atmospheric Explorer program. This book provides an overview of this program with particular emphasis on the AE3, AE4, and AE5 satellites, which represent early examples of problem-dedicated missions. Both the satellites and their instrumentation on the one hand and the experimental and scientific considerations in studying the thermosphere on the other are discussed. J.P.B.

N88-18085# California Inst. of Tech., Pasadena.
NUMERICAL STUDIES OF PROPAGATION OF Lg WAVES ACROSS OCEAN CONTINENT BOUNDARIES USING THE REPRESENTATION THEOREM (RT) Ph.D. Thesis
Janice Regan [1987] 247 p
Avail: Univ. Microfilms Order No. DA8719696

Methods for Representation Theorem (RT) coupling of finite element (FE) or finite difference and propagator matrix calculations are explained and developed. In particular the effects of an ocean continent transition region on the propagation of Lg waves are examined. Results show that passage through a region of thinning crust (continent ocean transition) increases the amplitude and coda length of the Lg wave at the surface, and allows much of the energy trapped in the crust to escape into the subcrustal layers as downgoing phases. Passage through a region of thickening crust (ocean continent transition), causes a rapid decrease in the Lg amplitude at the surface of the crust. Energy spreads from the thin oceanic crust throughout the continental crust. Downgoing phases incident on the continental crust are transmitted back into it. The attenuation of surficial Lg occurs in the oceanic structure and in the ocean to continent transition region. The total attenuation of Lg due to geometry for propagation along a partially oceanic path is at most a factor of four to six, inadequate to explain the observed attenuation. Dissert. Abstr.

N88-18086 Iowa State Univ. of Science and Technology, Ames.
STATISTICAL STUDIES OF LOW FREQUENCY OSCILLATIONS IN SATELLITE-OBSERVED STRATOSPHERIC TEMPERATURES Ph.D. Thesis
Xin-Hai Gao 1987 115 p
Avail: Univ. Microfilms Order No. DA8721884

Low frequency oscillations of the atmosphere (LFO) were investigated by analysis of four years of stratospheric brightness temperature (Tb) data from satellite-borne instruments. Several calculations involved in statistical studies are discussed. A modified lag correlation calculation is suggested. A method is provided for the estimation of degrees of temporal freedom of two correlated time series, utilizing their power spectra. A simple way to perform a half year summer/winter projection in the frequency domain is proposed. An alternative approach for empirical orthogonal function and extended empirical orthogonal function analysis is presented. These calculation methods perform statistical studies in the frequency domain and result in significant improvement of computational efficiency when band-pass filtered data are analyzed. Dissert. Abstr.

N88-18087 Utah Univ., Salt Lake City.
PARAMETERIZATION OF RADIATIVE TRANSFER IN THE EARTH'S ATMOSPHERE WITH SPECIFIC APPLICATIONS TO CLOUDS Ph.D. Thesis
Stefan August Kinne 1987 124 p
Avail: Univ. Microfilms Order No. DA8722646

The solar and infrared radiative transfer in the Earth's atmosphere is discussed. The main objectives are the development of time efficient radiative transfer methods for use in climate models and the determination of the radiative effects of clouds on atmospheric flux and heating rate profiles. A new two-stream method and a new broadband method for the transfer of fluxes have been developed. Both methods are based on adding principles. They explicitly account for multiple-scattering effects between reflecting layers. These methods are particularly suited for calculations in cloudy atmospheres. The results for fluxes and heating rates are within 5 percent of those obtained by an exact radiative transfer method. Dissert. Abstr.

N88-18088 Colorado Univ., Boulder.
PERSISTENCE CHARACTERISTICS OF 500 mb BLOCKING AND ZONAL FLOWS IN THE MID-LATITUDES OF THE NORTHERN AND SOUTHERN HEMISPHERES Ph.D. Thesis
Lesley Frances Tarleton 1987 231 p
Avail: Univ. Microfilms Order No. DA8716308

The definition, the geographical distribution, and persistence of blocking and intense zonal flows are studied and their characteristics compared statistically, in an attempt to determine whether these forms are extraordinary or if they are subsumed within the normal variations of atmospheric flow. The data set includes 35 years of Northern Hemisphere daily 500 mb geopotential height data and 8 years of Southern Hemisphere data. Experimental models (with and without topography, with and without external heating) have simulated blocking, but have not adequately explained blocking. Findings here suggest that blocking results from a stochastic process superimposed onto the mean long-wave pattern. Dissert. Abstr.

N88-18089 Stanford Univ., Calif.
SIMULATION AND MODELING OF WHISTLER MODE WAVE GROWTH THROUGH CYCLOTRON RESONANCE WITH ENERGETIC ELECTRONS IN THE MAGNETOSPHERE Ph.D. Thesis
Curtis Ray Carlson 1987 170 p
Avail: Univ. Microfilms Order No. DA8722972

New models and simulations of wave growth experienced by electromagnetic waves propagating through the magnetosphere in the whistler mode are presented. The main emphasis is to simulate single frequency wave pulses, in the 2 to 6 kHz range, that have

been injected into the magnetosphere, near L approximately 4. Simulations using a new transient model reproduce exponential wave growth and saturation coincident with a linearly increasing frequency versus time (up to 60 Hz/s). Unique methods for calculating the phased bunched currents, stimulated radiation, and radiation propagation are based upon test particle trajectories calculated by integrating nonlinear equations of motion generalized to allow the evolution of the frequency and wave number at each point in space. Results show the importance of the transient aspects in the wave growth process. The wave growth established as the wave propagates toward the equator is given a spatially advancing wave phase structure by the geomagnetic inhomogeneity. Through the feedback of this radiation upon other electrons, the conditions are set up which result in the linearly increasing output frequency with time. The transient simulations also show that features like growth rate and total growth are simply related to the various parameters, such as applied wave intensity, energetic electron flux, and energetic electron distribution. Dissert. Abstr.

N88-18090# Instituto de Fisica Teorica, Sao Paulo (Brazil).
ON HIGHER DERIVATIVE GRAVITY
A. J. Accioly 1987 21 p
(DE88-700619; IFT-P-10/87) Avail: NTIS (US Sales Only) HC A03/MF A01

A possible classical route conducting towards a general relativity theory with higher-derivatives starting, in a sense, from first principles, is analysed. A completely causal vacuum solution with the symmetries of the Goedel universe is obtained in the framework of this higher-derivative gravity. This very peculiar and rare result is the first known vacuum solution of the fourth-order gravity theory that is not a solution of the corresponding Einstein's equations. DOE

N88-18091*# Yale Univ., New Haven, Conn. Dept. of Geology and Geophysics.
APPLICATION OF SATELLITE DATA IN OBSERVATIONAL AND THEORETICAL STUDIES OF THE EVOLVING STRUCTURE OF BAROCLINIC WAVES Final Report, 29 Jul. 1982 - 31 Jul. 1987
Barry Saltzman Aug. 1987 84 p
(Contract NAS8-34903)
(NASA-CR-179277; NAS 1.26:179277) Avail: NTIS HC A05/MF A01 CSCL 04A

A variety of observational and theoretical studies were performed which were designed to clarify the relationship between satellite measurements of cloud and radiation and the evolution of transient and stationary circulation in middle latitudes. Satellite outgoing longwave radiation data are used to: (1) estimate the generation of available potential energy due to infrared radiation, and (2) show the extent to which these data can provide the signature of high and low frequency weather phenomena including blocking. In a significant series of studies the nonlinear, energetical, and predictability properties of these blocking situations, and the ralationship of blocking to the planetary, scale longwave structure are described. These studies form the background for continuing efforts to describe and theoretically account for these low frequency planetary wave phenomena in terms of their bimodal properties. Author

N88-18092# National Oceanic and Atmospheric Administration, Boulder, Colo. Environmental Sciences Group.
ANALYSIS OF QUASI-GEOSTROPHIC FORCING DURING THE AIMCS (AIRBORNE INVESTIGATIONS OF MESOSCALE CONVECTIVE SYSTEMS) PROJECT. VOLUME 2: RESULTS FOR JUNE 14 THROUGH JULY 16, 1984
S. L. Barnes Jul. 1987 138 p
(PB88-123807; NOAA-TM-ERL-ESG-27-Vol-2) Avail: NTIS HC A07/MF A01 CSCL 04A

Diagnostic results from twice-daily National Weather Service soundings for the 32-day Airborne Investigations of Mesoscale Convective Systems Project are presented in 64 multi-panel figures identified by date and time, information in each figure includes surface map for the sounding time, satellite IR images, 700 mb heights, 850 mb mixing ratio, 700 mb absolute geostrophic vorticity, 700 mb geostrophic temperature advection, 700 to 500 mb and 850 to 700 mb lapse rates, 700 mb Q-vectors superimposed on 850 to 500 mb layer-mean isotherms, 800 mb geostrophic frontogenesis function, 850 to 300 mb stability tendency, and divergence of Q fields for 800, 700, and 500 mb. GRA

N88-18093# Global Geochemistry Corp., Canoga Park, Calif.
ANALYSIS OF GASES IN THE EARTH'S CRUST Annual Report, Mar. 1986 - Feb. 1987
P. D. Jenden May 1987 142 p
(Contract GRI-5081-360-0533)
(PB88-141619; GRI-87/0328) Avail: NTIS HC A07/MF A01 CSCL 08G

One hundred thirty-one natural gas samples were collected for chemical analysis and stable isotopic measurements of carbon, hydrogen, nitrogen, sulfur, and helium. Studies of these and earlier samples have improved geochemical models for hydrocarbon exploration by: (1) augmenting the understanding of the origin and distribution of microbial gases; (2) introducing more effective ways of recognizing mixing between microbial and thermogenic gases; and (3) documenting a novel instance of reservoir alteration by bacteria. Based on the characteristics commonly attributed to deep-earth gas, it was concluded that deep-earth hydrocarbons are a minor component in most oil and gas reservoirs. Deep-earth carbon dioxide and nitrogen could be volumetrically more significant. These conclusions are currently being tested in the supergiant Hugoton-Panhandle gas production area of the U.S. Mid-continent. GRA

N88-18094# Woods Hole Oceanographic Institution, Mass.
DATA-BASE OF ANTARCTIC PRE-PLEISTOCENE SEDIMENT CORES
D. Lazarus, A. Pallant, and J. D. Hays May 1987 60 p Prepared in cooperation with Lamont-Doherty Geological Observatory, Palisades, N.Y.
(Grants NSF OCE79-19092; NSF DPP83-17087)
(PB88-124151; WHOI-87-16) Avail: NTIS HC A04/MF A01 CSCL 08G

A listing of high southern latitude (greater than 30 deg S) pre-Pleistocene sediment cores is given for samples obtained by the coring and drilling programs of the Lamont-Doherty Geological Observatory, the Antarctic Program of the Florida State University, the French Museum National d'Histoire Naturelle, and the Deep Sea Drilling Program. Information on geologic age, core length, lithology, bathymetry, and geographic location are given for each sediment samples. Ages of cores are given whenever possible to the nearest subepoch, together with (when known) the fossils used to determine the age, and the source of the age determination. Many core ages are from previously unpublished sources. The listing provides information on approximately 500 different cores. A computer-searchable version of the data base may be obtained by writing to the senior author. A brief analysis of latitudinal and bathymetric patterns of sedimentation is also given for the Paleogene, Miocene, and Pliocene of the Southern Ocean. GRA

N88-18095# Systems Applications, Inc., San Rafael, Calif.
TROPOSPHERIC ULTRAVIOLET RADIATION: ASSESSMENT OF EXISTING DATA AND EFFECT ON OZONE FORMATION Final Report, Mar. 1986 - Jul. 1987
M. W. Gery, R. D. Edmond, and G. Z. Whitten Nov. 1987 202 p Sponsored by EPA, Research Triangle Park, N.C. and National Park Service, Denver, Colo.
(PB88-130133; EPA/600/3-87/047) Avail: NTIS HC A10/MF A01 CSCL 04A

The impacts of future changes in stratospheric ozone and surface temperature on urban air quality were studied in two parts. The first part assessed the quality of existing ultraviolet data and approaches available for using these data to determine chemical photolysis rates. The second part involved testing the photochemical model for a number of urban data sets under conditions of decreased stratospheric ozone and increased surface temperature. The results indicated an increase in ambient ozone,

H2O2, and PAN concentration occur for most cities with decreasing ozone column. An increase in ambient temperature results in most cases with an increase in oxidants. PAN, however, which is temperature sensitive exhibits in many cases a decrease with increasing ambient temperature. Author

N88-18096# Alaska Univ., Fairbanks. Geophysical Inst.
A STUDY OF THE MAGNETIC FIELD ANNIHILATION PROCESS IN THE MAGNETOSPHERE AND SOME GEOTECHNICAL APPLICATIONS Summary Progress Report, 1 Aug. 1986 - 31 Jul. 1987
S. I. Akasofu and L. C. Lee May 1987 5 p
(Contract DE-FG06-86ER-13530)
(DE88-004165; DOE/ER-13530/1; GI-86-51b) Avail: NTIS HC A02/MF A01

In the past year, we made progress in the understanding of the multiple X-line reconnection process and the global multiple X-line reconnection at the dayside magnetopause. We also studied the plasma instabilities associated with the current sheets at the magnetopause and in the magnetotail. In addition, a new and efficient mechanism for the ion heating across a quasi-perpendicular shock was proposed. DOE

N88-18097*# Washington Univ., Seattle. College of Forest Resources AR10.
EVALUATION OF SURFACE ENERGY AND RADIATION BALANCE SYSTEMS ON THE KONZA PRAIRIE
Leo J. Fritschen 18 Jun. 1987 150 p
(Grant NAG5-521)
(NASA-CR-182534; NAS 1.26:182534) Avail: NTIS HC A07/MF A01 CSCL 04A

Four Surface Energy and Radiation Balance Systems (SERBS) were installed and operated for two weeks in Kansas during July of 1986. Surface energy and radiation balances were investigated on six sites on the Konza Prairie about 3 km south of Manhattan, Kansas. Measurements were made to allow the computation of these radiation components: total solar and diffuse radiation, reflected solar radiation, net radiation, and longwave radiation upward and downward. Measurements were made to allow the computation of the sensible and latent heat fluxes by the Bowen ratio method using differential psychrometers on automatic exchange mechanisms. The report includes a description of the experimental sites, data acquisition systems and sensors, data acquisitions system operating instructions, and software used for data acquisition and analysis. In addition, data listings and plots of the energy balance components for all days and systems are given. Author

N88-18098# Michigan Univ., Ann Arbor. Dept. of Atmospheric and Oceanic Science.
COLLABORATIVE STUDIES OF POLAR CAP IONOSPHERIC DYNAMICS Final Report, 10 Jun. 1983 - 30 Sep. 1985
J. W. Meriwether, Jr. and T. L. Killeen 12 Oct. 1987 45 p
(Contract F19628-83-K-0035)
(AD-A187888; AFGL-TR-87-0012) Avail: NTIS HC A03/MF A01 CSCL 04A

An important parameter in the modelling of polar cap ionospheric phenomena relating to scintillations and small scale irregularities is the thermospheric wind. The magnitude and direction of the flow of the neutral atmosphere determines how quickly these features of the polar cap morphology develop and grow. The AFGL contract was awarded to support the construction and installation of an automatic instrument designed to observe automatically thermospheric winds and temperatures at Thule Air Base in Greenland. The observatory was successfully operated throughout the 1985/1986 winter between early December 1985 and 1 April 1986. This report presents the description of the instrumentation and a set of plots showing the reduced set of observations for the clear nights in this period. GRA

N88-18099# Army Engineer Topographic Labs., Fort Belvoir, Va.
ESTIMATION OF GRAVITY VECTOR COMPONENTS FROM BELL GRAVITY GRADIOMETER AND AUXILIARY DATA UNDER CONSIDERATION OF TOPOGRAPHY AND ASSOCIATED ANALYTICAL UPWARD CONTINUATION ASPECTS
H. B. vonLuetzow 29 Jan. 1987 12 p
(AD-A188146; USAETL-R-104) Avail: NTIS HC A03/MF A01 CSCL 08E

The paper briefly discusses gravity gradiometer applications. It outlines the estimation of first order derivatives of the anomalous gravity potential from Bell gravity gradiometer and auxiliary data in the context of a Wiener-Kolmogorov optimization scheme under consideration of computable topographic noise, accomplished on the basis of the Pellinen-Moritz solution of the boundary value problem of physical geodesy. The paper also addresses four different methods of analytical upward continuation of first order derivatives of the anomalous gravity potential under identification of a finite difference method using Laplace's equation as the most economical and efficient one. GRA

N88-18100# Naval Research Lab., Washington, D.C.
THEORETICAL AND OBSERVATIONAL PROBLEMS WITH HOLES IN THE FAR UV DAYGLOW Final Report
R. R. Meier and T. A. Chubb 5 Nov. 1987 9 p Prepared in cooperation with Bendix Field Engineering Corp., Columbia, Md.
(AD-A188190; NRL-9078) Avail: NTIS HC A02/MF A01 CSCL 04A

Results of an OI 1304 A radiative transfer model indicate that it is highly unlikely that holes in the Dynamics Explorer-1 (DE-1) dayglow observations are caused by either absorptive material imbedded in the atmosphere or to a depletion of atomic oxygen in an atmospheric column. An alternative explanation of absorbing clouds between the spacecraft and the emitting atmosphere is not precluded by the theory. In addition, observations from a far UV experiment on Orbiting Geophysical Observatory-4 (OGO-4) are examined for events comparable to the DE-1 holes. Some 200 events would be expected from the OGO-4 N2 Lyman-Birge Hopfield (LBH) band data if the holes are atmospheric phenomena lasting on the order of minutes. Alternatively, if the holes are the result of passage of absorbing clouds across detector fields of view, 30 events would have been expected in OGO-4 data; however, their short occurrence time would make them difficult to detect, on the average. No evidence of holes was found in the OGO-4 data. GRA

47 METEOROLOGY AND CLIMATOLOGY

Includes weather forecasting and modification.

N88-18101# National Weather Service, Salt Lake City, Utah.
AEV LOCAL VERIFICATION FOR AVIATION, PRECIPITATION AND TEMPERATURE PROGRAMS: AV, REL, TEM (SEPTEMBER 1987 REVISION)
T. W. Barker Sep. 1987 42 p
(PB88-115662; NOAA-NWS-WRCP-42-Rev-2) Avail: NTIS HC A03/MF A01 CSCL 04B

These programs take advantage of the verification data available from the AFOS Era Verification (AEV) software. The AEV software maintains a short file which contains verification data for the previous few days. The software was developed to permanently save the verification data in large local files and create verification scores based on the data. This allows weather forecasters to see verification scores in a familiar format according to criteria which are much more specific than the national summaries could ever provide. The version also verifies local aviation statistics against persistence since, in general, MOS forecasts are no longer available at the same time as the local FT forecasts are verified. Author

N88-18102 Florida State Univ., Gainesville.
THE STRUCTURE AND DYNAMICS OF MONSOON DEPRESSIONS Ph.D. Thesis

Michael William Douglas 1987 299 p
Avail: Univ. Microfilms Order No. DA8721838

The structure and evolution of two depressions observed during the 1979 Summer Monsoon Experiment is described in detail with the objective of determining what changes took place during their intensification. The first depression was associated with the onset of the monsoon, while the second formed over the Bay of Bengal in early July, 1979. Detailed subjectively produced windfield analysis provides the basis for vorticity and heat and moisture budgets, as well as the four dimensional description of both depressions. The principal deduction from the analysis was that both depressions had many important features in common. These included a southwest tilt with height, asymmetric distribution of cloudiness and vertical motions, a local maximum in mid-tropospheric temperature just northeast of the center and pronounced thermal advection patterns below 500 mb. Dissert. Abstr.

N88-18103# Florida State Univ., Gainesville.
SYSTEMATIC ERRORS OF THE FSU GLOBAL SPECTRAL MODEL Ph.D. Thesis
Naomi Surgi 1987 159 p
Avail: Univ. Microfilms Order No. DA8721862

Three 20 day winter forecasts have been carried out using the Florida State University Global Spectral Model to examine the systematic errors of the model. Most global climate models and global forecast models exhibit the same kind of error patterns even though the model formulations vary somewhat between them. Some of the dominant errors are a breakdown of the trade winds in the low latitudes, an over prediction of the sub-tropical jets accompanied by an upward and poleward shift of the jets, an error in the mean sea level pressure with over-intensification of the quasi-stationary oceanic lows and continental highs and a warming of the tropical mid and upper troposphere. A number of sensitivity experiments were performed for which orography, modal physics and initialization are considered as possible sources of the errors. Dissert. Abstr.

N88-18104# Environmental Protection Agency, Research Triangle Park, N.C. Atmospheric Sciences Research Lab.
DEVELOPMENTS IN NATIONAL WEATHER SERVICE METEOROLOGICAL DATA COLLECTION PROGRAMS AS RELATED TO EPA (ENVIRONMETAL PROTECTION AGENCY) AIR POLLUTION MODELS Report, May 1986 - Oct. 1987
T. E. Pierce and D. B. Turner Nov. 1987 121 p
(PB88-130240; EPA/600/3-87/048) Avail: NTIS HC A06/MF A01 CSCL 04B

During the next decade, the National Weather Service (NWS) will be upgrading its meteorological instrumentation and data dissemination procedures. Because these changes will affect the operation of the U.S. Environmental Protection Agency's (EPA) air pollution models, the project has been undertaken to report on proposed changes and to recommend how to make optimal use of the new NWS data products. New instrumentation will include automated surface observation systems, next generation radar, and remote profilers. Data dissemination is being upgraded with an automated weather interactive processing system. GRA

N88-18105*# Wisconsin Univ., Madison. Space Science and Engineering Center.
MINIMUM ENERGY ROUTING THROUGH INTERACTIVE TECHNIQUES (MERIT) MODELING Final Report, 1 May 1985 - 30 Sep. 1986
Donald P. Wylie Mar. 1988 23 p
(Grant NAG1-592)
(NASA-CR-182535; NAS 1.26:182535) Avail: NTIS HC A03/MF A01 CSCL 04B

The MERIT program is designed to demonstrate the feasibility of fuel savings by airlines through improved route selection using wind observations from their own fleet. After a discussion of weather and aircraft data, manually correcting wind fields, automatic corrections to wind fields, and short-range prediction models, it is concluded that improvements in wind information are possible if a system is developed for analyzing wind observations and correcting the forecasts made by the major models. One data handling system, McIDAS, can easily collect and display wind observations and model forecasts. Changing the wind forecasts beyond the time of the most recent observations is more difficult; an Australian Mesoscale Model was tested with promising but not definitive results. J.P.B.

N88-18106*# Wisconsin Univ., Madison. Dept. of Statistics.
ON THE DYNAMIC ESTIMATION OF RELATIVE WEIGHTS FOR OBSERVATION AND FORECAST IN NUMERICAL WEATHER PREDICTION
Grace Wahba and A. Deepak, ed. Jan. 1988 6 p Presented at the International Workshop on Remote Sensing Retrieval Methods, Williamsburg, Va., 15-18 Dec. 1987
(Grants NAG5-315; NSF ATM-84-0373)
(NASA-CR-182531; WU-TR-818; NAS 1.26:182531) Avail: NTIS HC A02/MF A01 CSCL 04B

The problem of merging direct and remotely sensed (indirect) data with forecast data to get an estimate of the present state of the atmosphere for the purpose of numerical weather prediction is examined. To carry out this merging optimally, it is necessary to provide an estimate of the relative weights to be given to the observations and forecast. It is possible to do this dynamically from the information to be merged, if the correlation structure of the errors from the various sources is sufficiently different. Some new statistical approaches to doing this are described, and conditions quantified in which such estimates are likely to be good. Author

N88-18107# Naval Oceanographic Office, Bay St. Louis, Miss.
US NAVY CLIMATIC STUDY OF THE MEDITERRANEAN SEA
Jul. 1987 711 p
(AD-A188264; NAVAIR-50-1C-547) Avail: NTIS HC A99/MF E03 CSCL 04B

Presented are charts of cloud cover, precipitation, visibility tables, ceiling-visibility (midrange), ceiling-visibility (low range), wind-visibility-cloudiness, scalar, wind-speed, wind speed 11 and 34 knots, wind speed 11-21 and 22-23 knots, surface wind rose, air and sea temperature, wave height-isopleths, wave height tables, surface currents, and station climatic summaries for each month. GRA

N88-17617*# Mesoscale Environmental Simulations, Inc., Hampton, Va.
NASA WIND SHEAR MODEL: SUMMARY OF MODEL ANALYSES
Fred Proctor *In* NASA. Langley Research Center, Airborne Wind Shear Detection and Warning Systems: First Combined Manufacturers and Technologists Conference Jan. 1988 p 29-66 (For primary document see N88-17616 10-03)
Avail: NTIS HC A24/MF A01 CSCL 04B

48 OCEANOGRAPHY

Includes biological, dynamic, and physical oceanography; and marine resources.

For related information see also *43 Earth Resources and Remote Sensing.*

N88-18108# Skidaway Inst. of Oceanography, Savannah, Ga.
TRACE ELEMENT GEOCHEMISTRY OF THE SOUTH ATLANTIC BIGHT Progress Report
H. L. Windom Dec. 1987 6 p
(Contract DE-FG09-86ER-60435)
(DE88-003515; DOE/ER-60435/T3) Avail: NTIS HC A02/MF A01

A major field effort involves participation in FLEX, where some 350 samples are collected for trace metal analyses. All of the SPREX data has been reduced and interpreted. A model is described for the flux of particulate material across the continental shelf. This model was applied to the particulate aluminum data collected during SPREX and will be used to estimate cross-shelf

fluxes of particulate trace metals. The model will also serve as a basis for developing further models for freshwater, PON and POC fluxes during SPREX and FLEX. Also described is the estuarine behavior of Pu and Pb-210. Another paper describes trace metal behavior in the Savannah River estuary. All analyses and data reduction for Phase 1 and 2 sediment sampling campaigns are complete. A paper submitted for publication shows that the major metal bearing phase in these sediments is aluminosilicate minerals. These results are to be interpreted during the coming year to estimate nearshore sediment removal of trace metals and nutrients and their cycling. Analysis of all pre-FLEX suspended sediment samples is complete and will be used, with SPREX and FLEX data, to elucidate temporal variability on the composition of nearshore particles. DOE

N88-18109*# National Aeronautics and Space Administration, Washington, D.C.
NASA OCEANIC PROCESSES PROGRAM Biennial Report, fiscal years 1986 and 1987
Feb. 1988 183 p
(NASA-TM-4025; NAS 1.15:4025) Avail: NTIS HC A09/MF A01 CSCL 08C

An overview of the recent accomplishments, present activities, and future plans is provided. Sections following the introduction provides summaries of current flight projects and definition studies, brief descriptions of individual research activities, and a bibliography of referred Journal Articles appearing within the last three years. Author

N88-18110# Skidaway Inst. of Oceanography, Savannah, Ga.
COORDINATION: SOUTHEAST CONTINENTAL SHELF STUDIES Progress Report, 1 Jun. 1986 - 31 Dec. 1987
D. W. Menzel 11 Dec. 1987 31 p
(Contract DE-FG09-86ER-60450)
(DE88-003680; DOE/ER-60450/T1) Avail: NTIS HC A03/MF A01

The principal investigator coordinated activities associated with the conduct of research on the oceanography of the southeastern continental shelf. These activities included serving as a contact between program managers at DOE and principal investigators associated with the program, developing long-range research plans, providing DOE with summaries of the results of past and current research activities, conducting planning/reporting meetings involving principal investigators and interested agency personnel, and consolidating and scheduling the use of research vessels. DOE

N88-18111# Oregon State Univ., Corvallis. Coll. of Oceanography
CTD OBSERVATIONS IN THE COASTAL TRANSITION ZONE OFF NORTHERN CALIFORNIA, 16-25 FEBRUARY 1987
Richard E. Schramm, Jane Fleischbein, Adriana Huyer, and Michael P. Kosro Sep. 1987 70 p
(Contract N00014-87-K-0242)
(AD-A187283; DATA-137; REF-87-24) Avail: NTIS HC A04/MF A01 CSCL 08C

Wecoma cruise W8702B was conducted in February 1987 as part of the pilot study for the Coastal Transition Zone project. CTD observations were made in the coastal transition zone off northern California between 37.5 N and 41.5 N. Stations were planned along three alongshore transects, at distances of 60, 90 and 150 km from the coast. Strong winds (with speeds greater than 35 kts) prevented the completion of the survey, but 38 stations were completed successfully. They were concentrated along lines 60 and 90 km from the coast. Maximum sampling depth at most stations was 500 m. Temperature and salinity were measured at all stations; light transmission was also measured at the first 23 stations. This report presents vertical profile plots and tabulations of data at selected depths for each station, and vertical sections of temperature, salinity and density anomaly for the two long alongshore sections. GRA

N88-18112# Miami Univ., Fla. Geo-Acoustic Lab.
A DEEP-WATER OBS (OCEAN BOTTOM SEISMOMETER) ARRAY WITH REAL-TIME TELEMETRY Interim Report
Charles E. Abbott, Tokuo Yamamoto, Mohsen Badiey, and Altan Turgut Oct. 1987 34 p
(Contract N00014-87-G-0116)
(AD-A187404; RSMAS-TR-87-006; GAL-1004) Avail: NTIS HC A03/MF A01 CSCL 08K

A two-element, ocean bottom seismometer (OBS) array, operating in the ULV/VLF range, has been developed for use at depths of 2000 meters and inter-element spacing to 600 meters. Seismic periods between 1 and 200 seconds, accelerations of 10 to the minus 7th meters/sec sq, and pressure fluctuations of 1 pascal are within the system sensing limits. As such, investigations related to ambient ocean noise and low frequency ARI are possible. The array incorporates real-time radio telemetry to provide on-site, quick-look capability while eliminating ship tending and/or anchoring constraints. The array features rapid deployment and retrieval and observational periods of 5 days before recharging the buoy batteries. Total length of array cable is 3020 m. Each element of the array is composed of: a three axis set of medium-period seismometers, a differential pressure gauge and, to determine package orientation, two inclinometers and a north-seeker. All sensor signals are digitized within the underwater package and a single, coaxial mooring cable couples the seismic data from each element to a surface telemetry buoy where it is relayed, via radiofrequency, to a shipboard receiver for immediate storage and real-time analysis. GRA

N88-18113# Naval Ocean Research and Development Activity, Bay St. Louis, Miss.
RAPID UNDERWAY SEDIMENT CLASSIFICATION BY ELECTRICAL METHODS Final Report
Philip J. Valent, Edward C. Mozley, and Robert F. Corwin Aug. 1987 79 p
(AD-A187447; NORDA-211) Avail: NTIS HC A05/MF A01 CSCL 08C

The initial results of a technical feasibility study for using direct current (DC) electric resistivity, electromagnetic (EM), and induced polarization (IP) methods to classify surficial sea-floor sediments are reported. Analytical work performed and a review of related work show that both the DC and EM resistivity techniques can provide electrical resistivity measurements of sufficient resolution to classify sediments according to type (mud, clay, silt, sand, gravel, etc.). Both DC and EM antennas must be close to the sea-floor surface (within 10 m) so that surficial sediment resistivities can be sufficiently resolved to permit classification. To resolve the resistivity of a 1-m-thick surficial sea-floor sediment layer, the DC antennas must be deployed less than 1 m above the sea floor. Both DC and EM methods can adequately resolve the resistivity of a 6-m-thick surficial layer at a standoff distance of 10 m. Noise tests with an inverted Schlumberger array towed in the water column and on the sea floor show noise levels to be within acceptable limits. The development of the IP method for clay mineral detection is reported; it shows promise as a remote sediment underway sediment calssification system. GRA

N88-18114# Naval Ocean Research and Development Activity, Bay St. Louis, Miss.
RAPID UNDERWAY SEDIMENT CLASSIFICATION BY ELECTRICAL METHODS Final Report
Philip J. Valent, Edward C. Mozley, and Robert F. Corwin Aug. 1987 74 p
(AD-A187477; NORDA-211) Avail: NTIS HC A04/MF A01 CSCL 08C

The initial results of a technical feasibility study for using direct current (DC) electric resistivity, electromagnetic (EM), and induced polarization (IP) methods to classify surficial sea floor sediments are reported. Analytical work performed and a review of related work show that both the DC and EM resistivity techniques can provide electrical measurements of sufficient resolution to classify sediments according to type (mud, clay, silt, sand, gravel, etc.). Both DC and EM antennas must be close to the sea floor

surface (within 10 m) so that surficial sediment resistivities can be sufficiently resolved to permit classification. To resolve the resistivity of a 1-m thick surficial sea floor sediment layer, the DC antennas must be deployed less than 1 m above the sea floor. Both DC and EM methods can adequately resolve the resistivity of a 6-m thick surficial layer at a standoff distance of 10 m. Noise tests with an inverted Schlumberger array towed in the water column and on the sea floor show noise levels to be within acceptable limits. The development of the IP method for clay mineral detection is reported; it shows promise as a remote underway sediment classification system. development of the IP method for clay mineral detection is reported; this method shows considerable promise as a contributor to a remote underway sediment classification system. Keywords: Sediments, Electrical conductivity; Direct current resistivity. GRA

N88-18115# Naval Postgraduate School, Monterey, Calif.
NUMERICAL SIMULATIONS OF THE CALIFORNIA CURRENT: FILAMENT FORMATION AS RELATED TO BAROCLINIC INSTABILITY M.S. Thesis
David A. Olivier Sep. 1987 70 p
(AD-A187573) Avail: NTIS HC A04/MF A01 CSCL 08C

The California Current System, CCS, consists of four separate currents that are spatially and seasonally distributed of the west coast of the United States. They are: (1) the California Current, a southward flowing surface jet; (2) the California Undercurrent, a northward flowing sub-surface jet; (3) the Davidson Current, a poleward flowing surface jet north of Point Conception; and (4) the Southern California Countercurrent, a northward flowing surface current south of Point Conception in the California Bight. Offshore jets or filaments are a well observed phenomenon in the CCS. Their surface and subsurface structures as well as their spatial and temporal variability are well documented. The methods by which these filaments are formed is not as well understood as their structural form. The most common generation theories are: (1) variations in wind stress coupled with topographic irregularities, (2) dynamic instability, and (3) geostrophic turbulence. This thesis attempts to identify the factor(s) responsible for filament formation south of Cape Mendocino by numerically simulating the CCS using a two-layer, nonlinear, promitive equation model. It is shown that baroclinic instability is the primary method by which filaments are formed in this region and that other factors such as barotropic instability, friction and nonlinearities can alter the characteristics of the fastest growing baroclinically unstable wave. GRA

N88-18116# Naval Ocean Research and Development Activity, Bay St. Louis, Miss.
ENERGY TRANSFERS FOR MULTILAYER HYDRODYNAMIC OCEAN MODELS: GENERAL FORMULATION AND SPECIFIC EXAMPLES Final Report
Donna W. Blake Aug. 1987 109 p
(AD-A187604; NORDA-170) Avail: NTIS HC A06/MF A01 CSCL 08C

Two dynamic models, useful in studying ocean circulations, are treated: the inviscid multilayer hydrodynamic model and the inviscid multilayer reduced-gravity hydrodynamic model or, for brevity, the finite depth model and the reduced-gravity model. The two models are identical except that the velocity is required to be zero in the bottom layer of the reduced-gravity model. The latter model retains most of the physical properties of the finite depth model but has considerably fewer computational requirements. Two different formulations of the energetics are obtained: layer-layer and layer-interface. In both, the kinetic energy per unit area of a layer is specified. Both formulations are valid mathematically and physically so the selection of one depends on what types of energy transfers the user wishes to examine. The energetics, or energy analysis, is presented for a general multilayer case for both models and both formulations. The energetics in both formulations are considered for specific cases: the one-, two-, and three-layer cases for the finite depth model and the one and two active layer cases for the reduced-gravity model. GRA

N88-18117# Chicago Univ., Ill. Dept. of Geophysical Sciences.
ICE-SHELF RESPONSE TO ICE-STREAM DISCHARGE FLUCTUATION. PART 1: UNCONFINED ICE TONGUES
Douglas R. MacAyeal and Victor Barcilon 1987 21 p
(Contract N00014-86-K-0034)
(AD-A188147) Avail: NTIS HC A03/MF A01 CSCL 08L

Unsteady thickness and flow observed on the Ross Ice Shelf are thought to result primarily from fluctuations of ice streams and outlet glaciers that feed the ice shelf at its inland boundaries. Ice-stream discharge fluctuations constitute an independent means of forcing unsteady ice-shelf behavior, and their effect must be distinguished from those of oceanic and atmospheric climate to understand ice-shelf change. Ice-stream-generated fluctuations of a one-dimensional ice shelf are found to propagate through the ice shelf environment along the two characteristics of the hyperbolic governing equations. One characteristic permits instantaneous transmission of grounding-line velocity changes to all points downstream. The other characteristic represents slow transmission of grounding-line thickness changes along Lagrangian particle paths. GRA

N88-18118# Chicago Univ., Ill. Dept. of Geophysical Sciences.
ON THE BAROTROPIC MODEL OF THE OCEAN CIRCULATION
V. Barcilon, P. Constantin, and E. S. Titi 1987 15 p
(Contract N00014-86-K-0034)
(AD-A188148) Avail: NTIS HC A03/MF A01 CSCL 08C

This paper is concerned with the question of whether ocean circulation models have unique steady solutions. We consider this question for the simplest such model, namely that of a homogeneous wind-driven ocean, with bottom friction and no topography. We examine the mathematical properties of the solutions of a barotropic, wind driven ocean with bottom friction on both a beta- and f-plane. Except for small Rossby numbers, the uniqueness of the solutions of the corresponding partial differential equations is dependent on an a priori bound for the gradient of the velocity. For the f-plane, two drivings are considered which give rise to explicit, global unique solutions. For large Rossby numbers, a novel nonlocal, nonlinear boundary value problem, which does depend on the beta-effect, is obtained for the circulation. GRA

N88-18119# Army Cold Regions Research and Engineering Lab., Hanover, N.H.
PHYSICAL AND STRUCTURAL CHARACTERISTICS OF WEDDELL SEA PACK ICE
Anthony J. Gow, Stephen F. Ackley, Kurt R. Buck, and Kenneth M. Golden Aug. 1987 77 p
(AD-A188189; CRREL-87-14) Avail: NTIS HC A05/MF A01 CSCL 08L

During February and March 1980 the physical properties of Weddell Sea pack ice were investigated via core drilling of 66 floes located along the transect of 600 nautical miles from 64 deg S to 74 deg S latitude at roughly 40 deg W longitude. These studies revealed widespread frazil ice in amounts not known to exist in Arctic sea ice of comparable age and thickness. It is estimated from structure studies of 62 of the 66 floes that 54 percent of the total ice production of the Weddell Sea is generated as frazil. The disposition and exceptional thickness of the frazil show that mechanisms other than surface turbulence effects are involved and imply that the circulation and structure of the water in the upper levels of the Weddell Sea are significantly different from those in the Arctic basin. Salinities of both first-year and multi-year floes are notably higher than those of their Arctic counterparts because summer surface melting is rare or absent in the Weddell Sea; in the Arctic, downward percolating meltwater flushes through the ice and lowers its salinity. Fluorescence was evaluated as a means of revealing biological activity in Weddell Sea pack ice. It proved useful as an index of combined living and dead material in the ice, but measurements failed to establish any consistent relationship between fluorescence and salinity as suggested be earlier work in the Weddell Sea. GRA

51 LIFE SCIENCES (GENERAL)

N88-18120# Laboratoire d'Heliosynthese BP, Lavera (France).
RESEARCH ON A SOLAR BIOTECHNOLOGY BASED ON THE CULTURE OF PHOTOSYNTHETIC CELLS
C. Gudin, D. Chaumont, O. Desanti, and D. Pioline (Societe Francaise des Petroles BP, Courbevoie, France) 1986 42 p In FRENCH Prepared in cooperation with Societe Francaise des Petroles BP, 92 - Courbevoie (France)
(Contract ESE-R-037-F)
(DE88-900129; EUR-10099) Avail: NTIS (US Sales Only) HC A03

To evaluate the potential offered by different photosynthetic organisms, a study of the growth of Enteroporpha lingulata and Synechocystis sp. was conducted on a laboratory scale and several trials in batch culture. From a methodological point of view, the batch culture is the easiest way of comparing the growth physiology of two strains of cells. But this method does not permit taking account of the dynamic aspect on which the extrapolation of the trials on a large scale must be based. For this reason, the continuous culture system was chosen to compare the potential of two blue-green algae Synechocystis sp. (previously studied in batch system) and Spirulina maxima. Results and conclusions of this comparative ecophysiological study of the three strains, each of potential interest, are given. In conclusion, the research carried out in this project shows that the three strains have different behavior, but nevertheless, their specificity permits them to cover a wide range of applications according to the climatic conditions (25°C, 32°C, 42°C) and the nature of the water (polluted, brackish, salted). DOE

N88-18121# California Univ., Berkeley. Lawrence Berkeley Lab.
SPECTROSCOPIC STUDIES OF ENERGY TRANSFER IN PHOTOSYNTHETIC REACTION CENTERS OF HIGHER PLANTS Ph.D. Thesis
S. Tabbutt Sep. 1987 177 p
(Contract DE-AC03-76SF-00098)
(DE88-003850; LBL-24017) Avail: NTIS HC A09/MF A01

The focus of this thesis is excitation transfer and primary photochemistry in spinach chloroplasts and sub-chloroplast particles. The fluorescence kinetics are measured with a synchronously pumped, mode-locked dye laser excitation source and a reverse single photon-counting timing detection system. Very little has been reported on the fluorescence properties of photosystem I (PS I) due to its relatively weak emission compared to photosystem II (PS II). Using a PS I complex isolated from spinach, two emission bands, 690 nm and 722 nm were observed. The 690 nm fluorescence kinetics has an instrument limited (25 ps) rise and is best fit to three exponential decay components: slow, 2.2 to 2.5 ns; middle, 250 to 300 ps; and fast, 40 to 100 ps. Both the yield and kinetics are temperature independent (77 to 295 K). The 722 nm emission is dramatically temperature dependent. At 295 K the fluorescence lifetimes at 720 nm are identical to those at 690 nm. Upon lowering the temperature the lifetimes of all three decay components increase, a measurable risetime (more than 25 ps) grows at temperatures below 265 K, and the fluorescence intensity at 722 nm increases about 20-fold from 295 K to 77 K. These studies provide excitiation transfer rates and activation energies within the PS I centers. DOE

N88-18122# Joint Publications Research Service, Arlington, Va.
JPRS REPORT: SCIENCE AND TECHNOLOGY. USSR: SPACE BIOLOGY AND AEROSPACE MEDICINE, VOLUME 21, NO. 5, SEPTEMBER - OCTOBER 1987
25 Feb. 1988 162 p Transl. into ENGLISH of Kosmicheskaya Biologiya i Aviakosmicheskaya Meditsina (Moscow, USSR), v. 21, no. 5, Sep. - Oct. 1987 96 p
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Topics addressed include: effects of space flight; simian circadian rhythms; guppy development in weightlessness; histomorphometric analysis of rats; optokinetic simulation in vestibulospinal reflexes; vestibular semicircular canal model; carbon monoxide exposurel cardiovascular disease in flight personnel; effects of hypokinesia; radiation effects; toxic aspects of sulfur hexafluoride; and stress responses to weightlessness. For individual titles, see N88-18123 through N88-18147.

N88-18123# Joint Publications Research Service, Arlington, Va.
MEDICAL AND PSYCHOLOGICAL PROBLEMS OF ASSURING FLIGHT SAFETY UNDER PRESENT CONDITIONS c52
S. A. Bugrov and V. A. Ponomarenko *In its* JPRS Report: Science and Technology. USSR: Space Biology and Aerospace Medicine, v. 21, no. 5, Sep. - Oct. 1987 25 Feb. 1988 p 1-8 Transl. into ENGLISH from Kosmicheskaya Biologiya i Aviakosmicheskaya Meditsina (Moscow, USSR), v. 21, no. 5, Sep. - Oct. 1987 p 4-10 (For primary document see N88-18122 10-51)
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At the present time flight safety can be provided only if aviation medicine requirements are taken into consideration. Maintenance of good health, high performance, and profession longevity of the flight and ground crewmen requires that flight surgeons and aerospace medicine specialists revise their position and eliminate various shortcomings in their work. Those latter include: lack of data about correlations between health problems and decline of performance, risk factors and professional longevity; inadequate us of systemic analysis for evaluating man-machine interactions; low priority of the investigation needed to organize proper prophylaxis of diseases. Proposals and suggestions are discussed with respect to to the new types and methods of medical support of flight safety at the current and advanced levels of developmnent of aviation technology. Author

N88-18124# Joint Publications Research Service, Arlington, Va.
EFFECT OF SPACEFLIGHT FACTORS ON PRIMATE'S BLOOD CIRCULATION
S. V. Abrosimov, V. V. Zhidkov, D. K. Endeka, V. I. Lobachik, V. I. Korolkov, and Ye. A. Ilyin *In its* JPRS Report: Science and Technology. USSR: Space Biology and Aerospace Medicine, v. 21, no. 5, Sep. - Oct. 1987 25 Feb. 1988 p 9-14 Transl. into ENGLISH from Kosmicheskaya Biologiya i Aviakosmicheskaya Meditsina (Moscow, USSR), v. 21, no. 5, Sep. - Oct. 1987 p 10-13 (For primary document see N88-18122 10-51)
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Using radioactive isotopes, central, peripheral, and organ blood circulation was investigated in two rhesus monkeys before the 7 day space flight, 1.5 hours after touchdown, and 4 months after recovery. Blood distribution and shifts were measured in different body segments, viz. head, chest, abdomen, legs. Postflight measurements revealed a decrease of plasma and blood volume. Postflight measurements also demonstrated changes in cardiac output and stroke volume, decrease of total peripheral resistance, reduction of mean arterial pressure, and a slight increase of heart rate. Pulmonary blood flow velocity and time varied insignificantly and in a different manner. Blood was pooled in the legs. Blood flow velocity in the skin of the upper and lower body decreased while in muscles it increased above the baseline values. Postflight, muscles acted as a hemodynamic blood pool. The tolerance of both monkeys to the tilt test was satisfactory. It can be concluded that the monkeys tolerated the 7 day space flight well enough. Author

N88-18125# Joint Publications Research Service, Arlington, Va.
INFLIGHT SIMIAN CIRCADIAN RHYTHMS AND TEMPERATURE HOMEOSTASIS ABOARD COSMOS-1514 BIOSATELLITE
V. Ya. Klimovitskiy, A. M. Alpatov, F. M. Sulzman, C. A. Fuller, and M. C. MooreEde *In its* JPRS Report: Science and Technology. USSR: Space Biology and Aerospace Medicine, v. 21, no. 5, Sep. - Oct. 1987 25 Feb. 1988 p 15-22 Transl. into ENGLISH from Kosmicheskaya Biologiya i Aviakosmicheskaya Meditsina (Moscow, USSR), v. 21, no. 5, Sep. - Oct. 1987 p 14-18 (For primary document see N88-18122 10-51)
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In the course of a 5 day space flight of two rhesus monkeys the following parameters were recorded at an interval of 16 min: core body temperature (Tc), skin temperature (Ts), and morot activity (MA). The telemetric Tc sensor was implanted subcutaneously in the right axilla, Ts thermistor was attached to the right ankle, and the piezotape was fixed to the inner side of the vest. Circadian rhythms of Tc varied with a period of 24 hours in one monkey and 25 hours in the other. The daily Tc decreased on the average by 0.5 C, Ts fell immediately after launch and remained close to the lower limit throughout the flight. The Ts amplitude decreased 5-fold. Phases of the circadian rhythms of Ts changed and circadian rhythms of MA remained unchanged and equal to 24 hours. Author

N88-18126# Joint Publications Research Service, Arlington, Va.
EFFECT OF SPACEFLIGHT FACTORS ON PRIMATE HYDRATION HOMEOSTASIS
V. V. Zhidkov, S. V. Abrosimov, D. K. Endeka, G. I. Borisov, V. I. Lobachik, V. V. Korolkov, and Ye. A. Ilyin *In its* JPRS Report: Science and Technology. USSR: Space Biology and Aerospace Medicine, v. 21, no. 5, Sep. - Oct. 1987 25 Feb. 1988 p 23-27 Transl. into ENGLISH from Kosmicheskaya Biologiya i Aviakosmicheskaya Meditsina (Moscow, USSR), v. 21, no. 5, Sep. - Oct. 1987 p 19-22 (For primary document see N88-18122 10-51)
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Using nuclear physics methods, hydration homeostasis of three monkeys flown on Cosmos-1514 and Cosmos-1667 was investigated. Measurements were made before flight, 1.5 hours after touchdown, and during the recovery period. Total water content, extracellular, and tissue fluid volumes were measured and intracellular and interstitial fluid volumes were calculated. Postflight, all the animals showed hydration status changes of similar sign: total water content, intracellular and extracellular fluid volumes decreased. Most significant changes occurred in tissure and interstitial fluid volumes. Hydration status responses to space flight factors were variable and the above changes disappeared in the course of the recovery period. The variations recorded were viewed as adaptive. Author

N88-18127# Joint Publications Research Service, Arlington, Va.
EMBRYONIC DEVELOPMENT OF GUPPY IN WEIGHTLESSNESS
Ye. M. Cherdantseva *In its* JPRS Report: Science and Technology. USSR: Space Biology and Aerospace Medicine, v. 21, no. 5, Sep. - Oct. 1987 25 Feb. 1988 p 28-32 Transl. into ENGLISH from Kosmicheskaya Biologiya i Aviakosmicheskaya Meditsina (Moscow, USSR), v. 21, no. 5, Sep. - Oct. 1987 p 22-25 (For primary document see N88-18122 10-51)
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The program of the Cosmos-1514 flight included an experiment, the purpose of which was to study the effect of weightlessness on the embryonic development of the live-bearing guppy: three pregnant females were flown for 5 days. Prelaunch their embryos were at the stage of cerebral vesicle differentiation and somite formation; this implies that the basic stages of organogenesis developed in weightlessness. One female was fixed in Bouin's fluid two days post flight and the second fish was fixed nine days postflight. Fourteen days after flight the third female gave birth to 25 normal fry. Thereafter the fish was mated 6 more times, each time delivering normal offspring. In addition, the offspring of the second generation was normal. Histological analysis of the embryos that were developing in weightlessness revealed no abnormalities. It can be concluded that weightlessness produced no effect on the fish development, beginning with the stage of the axial complex formation. Author

N88-18128# Joint Publications Research Service, Arlington, Va.
HISTOMORPHOMETRIC ANALYSIS OF RAT BONES AFTER SPACEFLIGHT ABOARD COSMOS-1667 BIOSATELLITE
A. S. Kaplanskiy, G. N. Durnova, Z. F. Sakharova, and Ye. I. IlyinaKakuyeva *In its* JPRS Report: Science and Technology. USSR: Space Biology and Aerospace Medicine, v. 21, no. 5, Sep. - Oct. 1987 25 Feb. 1988 p 33-40 Transl. into ENGLISH from Kosmicheskaya Biologiya i Aviakosmicheskaya Meditsina (Moscow, USSR), v. 21, no. 5, Sep. - Oct. 1987 p 25-31 (For primary document see N88-18122 10-51)
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Bones of the rats flown on Cosmos-1667 were examined histologically and histomorphometrically. It was found that 7 day exposure to weightlessness led to osteoporosis in the spongy matter of proximal metaphyses of tibia and, although to a lesser extent, in the spongiosa of lumbar vertebrae whereas no signs of osteoporosis were seen in the spongy matter of iliac bones. Osteoporosis in the spongy matter of the above bones developed largely due to the inhibition of the bone neoformation, which was indicated by a decrease in the number and activity of ostooblasts. Increased bone resorption (as shown by a greater number and activity of the osteroclasts) was observed only in the spongy matter of tibial metaphyses. It is emphasized that a reduction of the number of highly active osteoblasts in spongy bones is one of the early signs of inhibition of bone neoformation and development of osteoporosis. Author

N88-18129# Joint Publications Research Service, Arlington, Va.
EFFECT OF WEIGHTLESSNESS ON REPLICATIVE FUNCTION OF RAT HEPATOCYTE DNA
G. S. Komolova, A. V. Zakaznov, and V. F. Makeyeva *In its* JPRS Report: Science and Technology. USSR: Space Biology and Aerospace Medicine, v. 21, no. 5, Sep. - Oct. 1987 25 Feb. 1988 p 41-45 Transl. into ENGLISH from Kosmicheskaya Biologiya i Aviakosmicheskaya Meditsina (Moscow, USSR), v. 21, no. 5, Sep. - Oct. 1987 p 31-34 (For primary document see N88-18122 10-51)
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The replicative function of DNA of liver cells of rats exposed to strong stress effects, e.g., suspension for 2.5 hours a day for 6 days, decreased. The rat studies onboard biosatellites of the Cosmos series have demonstrated that a prolonged exposure to microgravity (up to 22 days) is not a stressogenic factor for the DNA synthetic system of liver cells. The transition from 1 g to microgravity cannot be viewed as a strong stressor either, because the rate of DNA synthesis in liver cells at an early period of adaptation to microgravity remains within the normal limits. However, this parameter decreases significantly during the recovery period following 18 to 22 day flights. Therefore changes in cellular processes related to the DNA replicating function in hepatocytes should be expected to occur in the postflight period rather than at an early period of adaptation to microgravity. Author

N88-18130# Joint Publications Research Service, Arlington, Va.
RNA-SYNTHESIZING ACTIVITY IN RAT LIVER FOLLOWING FLIGHT ABOARD COSMOS-1667
V. F. Makeyeva and G. S. Komolova *In its* JPRS Report: Science and Technology. USSR: Space Biology and Aerospace Medicine, v. 21, no. 5, Sep. - Oct. 1987 25 Feb. 1988 p 46-49 Transl. into ENGLISH from Kosmicheskaya Biologiya i Aviakosmicheskaya Meditsina (Moscow, USSR), v. 21, no. 5, Sep. - Oct. 1987 p 34-36 (For primary document see N88-18122 10-51)
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The effect of a short-term flight (7 days) on the RNA synthetic activity in isolated nuclei of the rat liver and its content of nucleic acids was investigated. The postflight activity of RNA-polymerase, the key enzyme of RNA synthesis, increased. The endogenous synthesis of RNA in nuclei grew, probably due to the change in the activity of the RNA-polymerase. Conversely, the concentration of nuclei acids in the liver tended to decrease. The results obtained give evidence that the changes in the RNA synthetic apparatus of hepatocytes in short-term flights are similar in sign to those seen in long-term flights. Author

N88-18131# Joint Publications Research Service, Arlington, Va.
ROLE OF OPTOKINETIC STIMULATION IN VESIBULOSPINAL REFLEXES **c52**
Yu. V. Krylov, V. V. Ivanov, A. A. Podshivalov, and V. V. Zaritskiy

In its JPRS Report: Science and Technology. USSR: Space Biology and Aerospace Medicine, v. 21, no. 5, Sep. - Oct. 1987 25 Feb. 1988 p 50-56 Transl. into ENGLISH from Kosmicheskaya Biologiya i Aviakosmicheskaya Meditsina (Moscow, USSR), v. 21, no. 5, Sep. - Oct. 1987 p 36-41 (For primary document see N88-18122 10-51)

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Data are presented concerning the effect of optokinetic stimulation (OKS) on vestibulospinal reflexes and discusses mechanisms of interaction of the vestibular, optic, and proprioceptive sensors during their combined stimulation. The vestibulospinal reflexes were investigated using a 2 minute step test and simultaneous OKS that was produced on the head of the test subject. During the tests optokinetic nystagmus was recorded and the angle of the body rotation relative to the initial position was measured. It was found that during the step tests the body turned along the OKS direction, i.e., towards the slow component of optokinetic nystagmus. During leftward OKS the angle of rotation was larger than during rightward OKS: 406.4 + or - 75.9 deg and 207.5 + or - 40.7 deg, respectively. During leftward OKS loss of equilibrium was recorded 4.5 times more often than during rightward OKS. It was demonstrated that the capacity to track stimuli moving to the left is lower than that to pursue stimuli moving to the right. It was shown that there is a correlation between the rate of optokinetic nystagmus slow phase and the angle of body rotation during the step. It was concluded that optokinetic nystagmus can be used as an informative parameter when measuring statokinetic stability in repsonse to multisensory stimulation. Author

N88-18132# Joint Publications Research Service, Arlington, Va.
MEMBRANE MODEL OF CUPULA OR VESTIBULAR SEMICIRCULAR CANALS **c52**

A. V. Kondrachuk, A. A. Shipov, and S. P. Sirenko *In its* JPRS Report: Science and Technology. USSR: Space Biology and Aerospace Medicine, v. 21, no. 5, Sep. - Oct. 1987 25 Feb. 1988 p 57-67 Transl. into ENGLISH from Kosmicheskaya Biologiya i Aviakosmicheskaya Meditsina (Moscow, USSR), v. 21, no. 5, Sep. - Oct. 1987 p 41-47 (For primary document see N88-18122 10-51)

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A mathematical model of the time-course variations of the cupula of the semicircular canals of the vestibular apparatus is presented. The model is found to be in good agreement with experimental data which suggests that the cupular matter has viscosity-elasticity properties. Their role in the functioning of the vestibular apparatus is discussed in qualitative terms. The applicability of the membrane model to the description of the time-course variations of the cupula is considered. Author

N88-18133# Joint Publications Research Service, Arlington, Va.
INVESTIGATION OF EFFECTS OF SHORT-TERM EXPOSURE TO HIGH CONCENTRATIONS OF CARBON MONOXIDE ON OPERATOR'S PSYCHOPHYSIOLOGICAL FUNCTIONS **c52**

V. Ye. Yastrebov, V. V. Kustov, and S. M. Razinkin *In its* JPRS Report: Science and Technology. USSR: Space Biology and Aerospace Medicine, v. 21, no. 5, Sep. - Oct. 1987 25 Feb. 1988 p 68-72 Transl. into ENGLISH from Kosmicheskaya Biologiya i Aviakosmicheskaya Meditsina (Moscow, USSR), v. 21, Sep. - Oct. 1987 p 47-50 (For primary document see N88-18122 10-51)

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Experiments on volunteers, aged 26 to 40, demonstrated from a 10 minute exposure to carbon monoxide at a concentration of 900 + or - mg/cu m caused a significant decline of the quality of the operator's functions. The task performed was a two-dimensional compensatory tracking task combined with mental arithmetics. Some of the test subjects showed symptoms of mild CO intoxication which preceded disorders in the work and were accompanied by an increase of HbCO to 10 + or - 57 percent. Such an exposure to CO should be regarded as hazardous since it may increase the probability of erroneous actions, particularly, of the flying personnel. Author

N88-18134# Joint Publications Research Service, Arlington, Va.
HUMAN BLOOD GLUTAMIC ACID LEVEL WITH EXPOSURE TO HIGH AMBIENT CONCENTRATIONS OF AMMONIA **c52**

V. P. Savina, T. F. Vlasova, and Ye. B. Miroshnikova *In its* JPRS Report: Science and Technology. USSR: Space Biology and Aerospace Medicine, v. 21, no. 5, Sep. - Oct. 1987 25 Feb. 1988 p 73-77 Transl. into ENGLISH from Kosmicheskaya Biologiya i Aviakosmicheskaya Meditsina (Moscow, USSR), v. 21, no. 5, Sep. - Oct. 1987 p 50-52 (For primary document see N88-18122 10-51)

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Amino acid metabolism of men kept in an enclosed environment was investigated. A high concentration of ammonia produced a specific redistribution of free amino acids in plasma, with the content of glutamic acid increasing by the end of the study. The estimates of glutamic acid in blood can be used for assessing maximally allowable concentrations of ammonia in enclosed environments. Author

N88-18135# Joint Publications Research Service, Arlington, Va.
ANALYSIS OF WATER RECOVERED AFTER BEING USED FOR WASHING BY MEN AND WOMEN **c54**

A. A. Berlin and S. L. Chekanova *In its* JPRS Report: Science and Technology. USSR: Space Biology and Aerospace Medicine, v. 21, no. 5, Sep. - Oct. 1987 25 Feb. 1988 p 78-83 Transl. into ENGLISH from Kosmicheskaya Biologiya i Aviakosmicheskaya Meditsina (Moscow, USSR), v. 21, no. 5, Sep. - Oct. 1987 p 53-57 (For primary document see N88-18122 10-51)

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The composition of wash water used by men and women was investigated. The results were exposed to multifactorial statistical analysis using the method of principal components. The investigations allowed the following conclusions to be made: (1) wash water used by men and women is comparable in composition; therefore, the sex of the crewmembers of space vehicles can be disregarded when designing water reclamation systems; (2) three parameters, viz. oxidability, electric conductivity, and chloride content, can be adequately used to assess the quality of utilized wash water; and (3) the composition of wash water is largely dependent on the health status of its users. Author

N88-18136# Joint Publications Research Service, Arlington, Va.
FORECASTING COMPLICATIONS OF CARDIOVASCULAR DISEASE IN FLIGHT PERSONNEL **c52**

G. L. Strongin, A. S. Turetskaya, B. L. Gelman, and O. N. Rodionov *In its* JPRS Report: Science and Technology. USSR: Space Biology and Aerospace Medicine, v. 21, no. 5, Sep. - Oct. 1987 25 Feb. 1988 p 84-90 Transl. into ENGLISH from Kosmicheskaya Biologiya i Aviakosmicheskaya Meditsina (Moscow, USSR), v. 21, no. 5, Sep. - Oct. 1987 p 57-62 (For primary document see N88-18122 10-51)

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The flying personnel of different age groups, including those who continued their professional activity and those who were grounded because of cardiovascular diseases, were followed up for a long period of time. The prognostic value, sensitivity, specificity of various risk factors, symptom, and syndromes of cardiovascular diseases were investigated. Using mathematical prediction methods (Wald's sequential nonhomogeneous statistical test), a diagnostic table for predicting outcomes of cardiovascular diseases for the immediate 5 years was developed. The table was checked and tested on a control sample. The trial showed that the table provided a better accuracy of prediction than the traditional methods normally used to the expertise practice. Author

N88-18137# Joint Publications Research Service, Arlington, Va.
EVALUATION OF SPARE ROOM IN CEREBROSPINAL SYSTEM USING NONINVASIVE METHODS **c52**

L. G. Simonov, A. K. Tsaturyan, A. S. Saribekyan, and L. G. Shmidt *In its* JPRS Report: Science and Technology. USSR: Space Biology and Aerospace Medicine, v. 21, no. 5, Sep. - Oct. 1987 25 Feb. 1988 p 91-95 Transl. into ENGLISH from Kosmicheskaya Biologiya i Aviakosmicheskaya Meditsina (Moscow,

USSR), v. 21, no. 5, Sep. - Oct. 1987 p 62-65 (For primary document see N88-18122 10-51)
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A theory according to which fluid volumes and pressures in the cerebrospinal system should be related nonlinearly rather than exponentially. The curve describing elasticity E as a function of pressure P should have two almost linear segments separated by an intercept. This concept is based on experimental and model data suggesting that the cerebrospinal system can be viewed as an elastic cavity which can, at normal and low pressures, trap an additional volume of any CSF component, and shift other components; as a result, this leads to a linear increase in pressure within the cavity. The theoretical concepts found support in comparative invasive-noninvasive studies of the intracranial fluid with the aid of ultrasonic introscopy and in postural tests to which patients with cerebral lesions were exposed. A noninvasive tehcnique for measuring fluid volumes and pressures in the cerebrospinal cavity was developed. The technique can be used as a dignostic tool in the case of intracranial distension.

N88-18138# Joint Publications Research Service, Arlington, Va.
ISOTOPE METHODS OF DETERMINING DISTRIBUTION AND MOVEMENT OF BLOOD IN THE BODY **c52**
V. I. Lobachik, V. N. Korsunskiy, V. I. Popov, S. V. Abrosimov, V. V. Zhidkov, and V. A. Andretsov *In its* JPRS Report: Science and Technology. USSR: Space Biology and Aerospace Medicine, v. 21, no. 5, Sep. - Oct. 1987 25 Feb. 1988 p 96-100 Transl. into ENGLISH from Kosmicheskaya Biologiya i Aviakosmicheskaya Meditsina (Moscow, USSR), v. 21, no. 5, Sep. - Oct. 1987 p 65-67 (For primary document see N88-18122 10-51)
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Migration of blood into the capacitive vessels of the upper half of the body is one of the vivid manifestations of the effect of weightlessness on man. Basic research on the phenomenon of redistribution of blood during space flight is difficult. For this reason, researchers are trying to solve a number of ground-based model experiments with anti-orthostatic hypokinesia. The use of radiotracer methods as a contribution to the problem solving, is discussed. B.G.

N88-18139# Joint Publications Research Service, Arlington, Va.
MUSCLE PRESERVATION IN THE STUDY OF BIOENERGETIC EFFECTS OF HYPOKINESIA **c52**
E. S. Mailyan and L. B. Buravkova *In its* JPRS Report: Science and Technology. USSR: Space Biology and Aerospace Medicine, v. 21, no. 5, Sep. - Oct. 1987 25 Feb. 1988 p 101-104 Transl. into ENGLISH from Kosmicheskaya Biologiya i Aviakosmicheskaya Meditsina (Moscow, USSR), v. 21, no. 5, Sep. - Oct. 1987 p 67-70 (For primary document see N88-18122 10-51)
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When studying oxidative phosphorylation in skeletal muscles, a strict time limit on preparing tissues is a mandatory prerequisite. Freezing methods inevitably involve water-ice-water phase transitions. A method of low-temperature preservation of skeletal muscles was developed for subzero temperatures, which precludes the possibility of water crystallization. Muscle tissue was immersed in 20 percent gylcerin solution prepared on isolation media (IM) cooled to -5 C and stored on saccharose ice. Two days later conventional methods were used to determine the parameters of oxidative phosphorylation. The use of this method of preserving muscles is justified for the study of energetic reactions in post flight studies. B.G.

N88-18140# Joint Publications Research Service, Arlington, Va.
SHORT- AND LONG-TERM EFFECTS OF NONLETHAL LEVELS OF FAST HIGH-ENERGY HELIUM IONS ON RETENTION OF DEVELOPED AND FORMATION OF NEW BEHAVIORAL PATTERNS IN RATS
N. Ya. Savchenko *In its* JPRS Report: Science and Technology. USSR: Space Biology and Aerospace Medicine, v. 21, no. 5, Sep. - Oct. 1987 25 Feb. 1988 p 105-108 Transl. into ENGLISH from Kosmicheskaya Biologiya i Aviakosmicheskaya Meditsina (Moscow, USSR), v. 21, no. 5, Sep. - Oct. 1987 p 70-72 (For primary document see N88-18122 10-51)
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The effect of fast helium ions with an energy of 4 GeV/nucleon was investigated. Rats were used to study the retention of developed behavioral skills and formations of new ones following nonlethal exposure in a changing situation with increased sensory input. It was shown that investigtions of rat behavior in a complicated maze is an integral parameter that yields rather complete information about the function of the Central Nervous System (CNS). Worsening of reflex activity was demonstrated 6 and 24 hours after irradiation (manifested by an increase in number of mistakes, prolongation of mean latency period, and increased locomotor response time). A decrease in number of mistakes, latency period, and locomotor response time was observed 5 to 7 days after irradiation. Restoration of some CNS functions, which occurred in the first week, was indicative of developing of compensatory processes. B.G.

N88-18141# Joint Publications Research Service, Arlington, Va.
MYOSIN Ca SUP (2+), Mg SUP (2+)-ADENOSINE TRIPHOSPHATASE ACTIVITY IN RAY MYOCARDIUM FOLLOWING 30-DAY EXPOSE TO 1.1 AND 2.0 G
I. B. Krasnov and Ye. A. Nosova *In its* JPRS Report: Science and Technology. USSR: Space Biology and Aerospace Medicine, v. 21, no. 5, Sep. - Oct. 1987 25 Feb. 1988 p 109-112 Transl. into ENGLISH from Kosmicheskaya Biologiya i Aviakosmicheskaya Meditsina (Moscow, USSR), v. 21 p 72-74 (For primary document see N88-18122 10-51)
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The decline in myosin Ca(2+), Mg(2+)-ATPase in the myocardium of rats flown in space for 18.5 to 22 days aboard Cosmos series biosatellites is viewed as the consequence of absence of sufficient load on the muscular system of the heart in weightlessness, and it is assessed as one of the manifestations of the heart in weightlessness, and it is assessed as one of the manifestations of mammalian adaptation to this state. Data concerning the level of activity of myosin Ca(2+), Mg(2+)-ATPase in the myocardium of rats exposed to both hypergravity (HG) produced during rotation on a centrifuge and relatively reduced gravity (RRG) would be of considerable interest with respect to broadening the ideas about the possibility of adaptation of mammals to altered gravity. The RRG is viewed as a state that arises as a result of reduction in weight (but not mass) of an organism following change from hypergravity, to which the body adapted, to earth's gravity. The RRG state apparently lasts until there is adaptation to earth's gravity of receptor structures that perceive changes in gravity, as well as structures of the nervous and endocrine systems that form the body's response to change in gravity. It can be assumed the changes arising in weightlessness and RRG in structures and systems that perceive change in gravity and effect adaptation to this change will be in the same direction. The objective was to examine the activity of myosin Ca(2+), Mg(2+)-ATPase in the myocardium of rates submitted for 30 days of HG to 1.1 and 2.0 G, as well as RRG for 2 days after discontinuing exposure to the above level of gravity for 30 days.
Author

N88-18142# Joint Publications Research Service, Arlington, Va.
KINETIC TOXIC ASPECT OF POTENTIAL USE OF SULFUR HEXAFLUORIDE IN CLOSED ENVIRONMENTS
S. S. Pashin, V. F. Ushakov, A. I. Gorshunova, N. Ye Ostasheva, Ye. B. Stadukhin, and E. I. Chukhno *In its* JPRS Report: Science and Technology. USSR: Space Biology and Aerospace Medicine, v. 21, no. 5, Sep. - Oct. 1987 25 Feb. 1988 p 113-119 Transl. into ENGLISH from Kosmicheskaya Biologiya i Aviakosmicheskaya Meditsina (Moscow, USSR), v. 21, no. 5, Sep. - Oct. 1987 p 74-77 (For primary document see N88-18122 10-51)
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The effect of sulfur hexafluoride (SF6 gas) on the body was attributed to its use as an experimental model in the study of the effects of high density gas environments on respiration under

hyperbaric conditions. The absence of deaths of experimental animals, even with use of maximum possible concentrations and long exposure time, led to the conclusion that pure SF6 is nontoxic. Single exposure to SF6 gas in concentrations of 1500 and 300 g/cu m led to the decline of function parameters of the central nervous system (CNS) of experimental animals. With chronic exposure in concentrations of 77 and 9.8 g/cm in addition to the effect of the CNS, there was a decline in renal function and an insignificant response of parameters of peripherl blood. Questions related to intake, distribution, and elimination of SF6 gas which were not covered in literature are covered. B.G.

N88-18143# Joint Publications Research Service, Arlington, Va.
COMPARATIVE EVALUATION OF ORTHOSTATIC STABILITY FOLLOWING IMMERSION IN HORIZONTAL AND VERTICAL POSITIONS **c52**
A. Yu. Modin *In its* JPRS Report: Science and Technology. USSR: Space Biology and Aerospace Medicine, v. 21, no. 5, Sep. - Oct. 1987 25 Feb. 1988 p 120-122 Transl. into ENGLISH from Kosmicheskaya Biologiya i Aviakosmicheskaya Meditsina (Moscow, USSR), v. 21, no. 5, Sep. - Oct. 1987 p 77-79 (For primary document see N88-18122 10-51)
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Among methods for ground-based simulation of weightlessness, the anti-orthostatic variant of bedrest (head-down tilt) and water immersion have gained the greatest population. The redistribution of fluids and hypodynamia syndrome that are thus simulated are based on various mechanisms. While simulation of these effects by the anti-orthostatic method imposes certain requirements as to position and locomotor activity, these requirements are not as apparent. Theoretically, it could be assumed that compensation of gravity by the ejecting force of the immersion medium levels off both posture-dependent hemodynamic effects of gravity and antigravity component of work associated with motor activity. In particular, there is information to the effect that there is virtually the some polyuric response in horizontal and vertical positions during immersion. This warrants the assumption that the nature of distribution of circulating blood does not change appreciably when the body position is changed in the immersion fluid. The objective was to make a comparative study of the effect of immersions in horizontal and veritical positions on orthostatic resistance of man. Author

N88-18144# Joint Publications Research Service, Arlington, Va.
COMPARATIVE EVALUATION OF STRESS REPSONSE OF RATS TO DIFFERENT METHODS OF SIMULATING SOME EFFECTS OF WEIGHTLESSNESS
G. N. Durnova, Ye. V. Vorotnikova, and N. G. Prodan *In its* JPRS Report: Science and Technology. USSR: Space Biology and Aerospace Medicine, v. 21, no. 5, Sep. - Oct. 1987 25 Feb. 1988 p 123-126 Transl. into ENGLISH from Kosmicheskaya Biologiya i Aviakosmicheskaya Meditsina (Moscow, USSR), v. 21, no. 5, Sep. - Oct. 1987 p 79-81 (For primary document see N88-18122 10-51)
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When simulating some of the effects of weightlessness by means of restricting movements or suspension, rats present an acute stress response, the severity and duration of which vary appreciably, depending on the chosen model of weightlessness. A comparative evaluation was made of the stress reaction, using morphological methods, to the most widely used methods of simulating weightlessness, and the nature and severity of this reponse was judged according to the changes in the adrenals and lymphoid organs that depend on them. Author

N88-18145# Joint Publications Research Service, Arlington, Va.
EFFECT OF ANTIORTHOSTATIC POSITION AND DIFFERENT ILLUMINATION ON SENSITIVITY OF SKIN IN UPPER HALF OF THE BODY TO ULTRAVIOLET RADIATION **c52**
I. V. Zubkova, L. V. Gutorova, and N. Ye. Panferova *In its* JPRS Report: Science and Technology. USSR: Space Biology and Aerospace Medicine, v. 21, no. 5, Sep. - Oct. 1987 25 Feb. 1988 p 127-129 Transl. into ENGLISH from Kosmicheskaya Biologiya i Aviakosmicheskaya Meditsina (Moscow, USSR), v. 21, no. 5, Sep. - Oct. 1987 p 81-82 (For primary document see N88-18122 10-51)
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No previous studies were made of the effect of redistribution of blood to the upper half of the body, which is inherent in weightlessness, on sensitivity of the skin to ultraviolet radiation (UVR). There is sparse and contradictory information as well concerning the effect of illumination of the skin on its sensitivity to UVR. There are data indicative of both attenuation and enhancement of UV sensitivity of the skin in daylight. For this reason, it is of practical interest to explore questions of the effects of antiorthostatic (head-down tilt) hypokinesia (HDT) and varying degrees of illumination on the body's capacity to perceive UVR when selecting conditions for preventive exposure of operators to UVR during space flights. Author

N88-18146# Joint Publications Research Service, Arlington, Va.
DISCRETE ADAPTATION TO SENSORY CONFLICT **c53**
B. I. Polyakov *In its* JPRS Report: Science and Technology. USSR: Space Biology and Aerospace Medicine, v. 21, no. 5, Sep. - Oct. 1987 25 Feb. 1988 p 130-137 Transl. into ENGLISH from Kosmicheskaya Biologiya i Aviakosmicheskaya Meditsina (Moscow, USSR), v. 21, no. 5, Sep. - Oct. 1987 p 82-86 (For primary document see N88-18122 10-51)
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According to current conceptions, impairment of the customary forms of interaction of afferent systems (sensory conflict) is the principal etiological factor of motion sickness (MS), including its space form. Individual differences in resistance to MS are attributable to the properties of adaptive systems, including the adrenosympathetic system. The process of adaptation can be enhanced via several basically different pathways. These pathways are briefly discussed. B.G.

N88-18147# Joint Publications Research Service, Arlington, Va.
SECOND ALL-UNION CONFERENCE ON PHYSIOLOGY OF EXTREME STATES AND INDIVIDUAL PROTECTION OF MAN **c52**
S. G. Salivon *In its* JPRS Report: Science and Technology. USSR: Space Biology and Aerospace Medicine, v. 21, no. 5, Sep. - Oct. 1987 25 Feb. 1988 p 138-143 Transl. into ENGLISH from Kosmicheskaya Biologiya i Aviakosmicheskaya Meditsina (Moscow, USSR), v. 21, no. 5, Sep. - Oct. 1987 p 86-89 (For primary document see N88-18122 10-51)
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Topics discussed at the conference were problems concerned with the effects of adverse ambient temperatures, altered barometric pressure, and toxic factors. Also discussed were psychological problems of human performance under extreme conditions, methods of correcting and restoring the functional state with exposure to extreme factors, questions of individual protection of man and automation of scientific research. B.G.

N88-18148*# National Aeronautics and Space Administration. John F. Kennedy Space Center, Cocoa Beach, Fla.
SPECIES BIOLOGY AND POTENTIAL FOR CONTROLLING FOUR EXOTIC PLANTS (AMMOPHILA ARENARIA, CARPOBROTUS EDULIS, CORTADERIA JUBATA AND GASOUL CRYSTALLINUM) ON VANDENBERG AIR FORCE BASE, CALIFORNIA
Paul A. Schmalzer and C. Ross Hinkle (Bionetics Corp., Cocoa Beach, Fla.) Oct. 1987 103 p
(Contract NAS10-10285)
(NASA-TM-100980; NAS 1.15:100980) Avail: NTIS HC A06/MF A01 CSCL 06C

Invasive exotic plants can displace native flora and modify community and ecosystem structure and function. Ammophila arenaria, Corpobrotus edulis, Cortaderia jubata, and Gasoul crystallinum are invasive plants present on Vandenberg Air Force Base, California, designated for study by the Environmental Task Force because of the perceived threat they represent to the native flora. Each plant's native habitat, how they came to be at

Vandenberg, their propagation, and how they can be controlled is discussed. Author

N88-18149# Health Effects Research Lab., Research Triangle Park, N. C.
EXPERIMENTAL MEASUREMENTS OF THE UPTAKE OF OZONE IN RATS AND HUMAN SUBJECTS
T. R. Gerrity and M. J. Wiester Oct. 1987 16 p
(PB88-125422; EPA/600/D-87/319) Avail: NTIS HC A03/MF A01 CSCL 06A

Experimental determination of ozone (O3) uptake in the conducting airways and lungs is a fundamental starting point for interspecies comparisons of delivered dose. Fractional O3 uptake was measured in the respiratory tract of awake Fischer 344 rats and in the lungs and nasophraynx of young healthy male humans. Awake animals were individually evaluated during nose only exposures to 0.3 ppm O3 for O3 removal, O2 consumption, CO2 production, and tidal breathing while inside a body plethysmograph. Utilizing these values of O3 uptake and measures of ventilation, the mass dose rate of O3 per unit respiratory tract surface area was computed and found to be similar between rats and humans for the same ambient O3 concentration. GRA

N88-18150# Joint Publications Research Service, Arlington, Va.
JPRS REPORT: SCIENCE AND TECHNOLOGY. USSR: SPACE BIOLOGY AND AEROSPACE MEDICINE, VOLUME 21, NO. 6, NOVEMBER - DECEMBER 1987
O. G. Gazenko, ed. 11 Mar. 1988 149 p Transl. into ENGLISH of Kosmicheskaya Biologiya i Aviakosmicheskaya Meditsina (Moscow, USSR), v. 21, no. 6, Nov. - Dec. 1987 95 p
(JPRS-USB-88-004) Avail: NTIS HC A07/MF A01

Topics addressed include: aerospace medicine; electrocardiography; human tolerance to acceleration; effects of weightlessness on rats; effect of oxygen inhalation on respiratory function; cardiorespiratory parameters; hemodynamics; and space flight stress. For individual titles, see N88-18151 through N88-18172.

N88-18151# Joint Publications Research Service, Arlington, Va.
PRESENT STAGE OF SPACE MEDICINE **c52**
B. S. Alyakrinskiy *In its* JPRS Report: Science and Technology. USSR: Space Biology and Aerospace Medicine, v. 21, no. 6, Nov. - Dec. 1987 11 Mar. 1988 p 1-9 Transl. into ENGLISH from Koshmicheskaya Biologiya i Aviakosmicheskaya Meditsina (Moscow, USSR), v. 21, no. 6, Nov. - Dec. 1987 p 3-10 (For primary document see N88-18150 10-51)
Avail: NTIS HC A07/MF A01

Development of Soviet cosmonautics has resulted in considerable achievements referable to many disciplines, including biology and medicine, which originated new scientific directions. Numerous important problems were formulated and solved; results of broad scientific relevance were obtained, and, at the same time, new difficult problems were advanced, which require bold overcoming of many dogmas reinforced by tradition, restructuring of scientific thinking. The real achievements of such restructuring will be the contribution of space medicine to the advances, with which the Soviet Union is celebrating its 70th anniversary of the Great October Socialist Revolution. Author

N88-18152# Joint Publications Research Service, Arlington, Va.
RESULTS OF LONG-TERM ELECTROCARDIOGRAPHIC MONITORING OF COSMONAUTS **c52**
Ye. M. Romanov, N. P. Artamonova, Z. A. Golubchikova, A. F. Zavadovskiy, M. M. Korotayev, V. R. Lyamin, and V. D. Turbasov *In its* JPRS Report: Science and Technology. USSR: Space Biology and Aerospace Medicine, v. 21, no. 6, Nov. - Dec. 1987 11 Mar. 1988 p 10-16 Transl. into ENGLISH from Kosmicheskaya Biologiya i Aviakosmicheskaya Meditsina (Moscow, USSR), v. 21, no. 6, Nov. - Dec. 1987 p 10-14 (For primary document see N88-18150 10-51)
Avail: NTIS HC A07/MF A01

Regular electrocardiographic examinations of 21 cosmonauts who made 42 space flights during the years 1964 through 1985 are summarized. Electrocardiographic examinations were performed before, during, and after flight. The most common ECG abnormality recorded was extrasystolic arrhythmia that occurred very frequently during provocative tests. In long-term flights changes in the phase of ventricular repolarization were predominant due to the effects of microgravity and other flight factors. The ECG changes were transient and of insignificant prognostic value. Long after return to Earth three cosmonauts developed ECG changes typical of myocardial infarction, hypertension, or hypertension combined with latent ischemic heart disease. It is maintained that these pathologies were not caused by exposure to space flight effects. Author

N88-18153# Joint Publications Research Service, Arlington, Va.
IMPROVEMENT OF HUMAN TOLERANCE TO HEAD-PELVIS (+Gz) ACCELERATIONS BY INCREASING HYDRATION **c52**
A. R. Kotovskaya, S. Baranski, D. Gembizka, M. Voitkowjak, I. F. VilVilyams, and N. I. Kokova *In its* JPRS Report: Science and Technology. USSR: Space Biology and Aerospace Medicine, v. 21, no. 6, Nov. - Dec. 1987 11 Mar. 1988 p 17-22 Transl. into ENGLISH from Kosmicheskaya Biologiya i Aviakosmicheskaya Meditsina (Moscow, USSR), v. 21, no. 6, Nov. - Dec. 1987 p 14-18 (For primary document see N88-18150 10-51)
Avail: NTIS HC A07/MF A01

Experiments were performed to determine tolerance to head-to-feet (+Gz) acceleration in 62 test subjects aged 23 to 33. The subjects were rotated in a human centrifuge before and after they consumed water and water-salt supplements under the conditions of normal activity or dry immersion simulating microgravity effects. During the centrifugation experiments the following parameters were recorded: stroke volume and cariac output, arterial pressure by means of Korotkov sounds, electrolytes, total protein, and hemacrit. Water and water-salt supplements were found to produce a beneficial effect on acceleration tolerance: tolerance grew, cardiac arrhythmias developed less frequently. The efficacy of the methods increasing the hydration level was related to the amount of water consumed and retained in the body. It is recommended that a differential approach be used to develop procedures for increasing body hydration to be employed in aerospace medicine. Author

N88-18154# Joint Publications Research Service, Arlington, Va.
EFFECT OF SPACEFLIGHT FACTORS ON BIOLOGICAL MATERIAL FLOWN ABOARD COSMOS-1514 BIOSATELLITE
Y. Gaubin, M. Delpoux, J. Bionov, H. Planel, G. Gasset, B. Pianezzi, M. Burg, and A. Barbast *In its* JPRS Report: Science and Technology. USSR: Space Biology and Aerospace Medicine, v. 21, no. 6, Nov. - Dec. 1987 11 Mar. 1988 p 23 Transl. into ENGLISH from Kosmicheskaya Biologiya i Aviakosmicheskaya Meditsina (Moscow, USSR), v. 21, no. 6, Nov. - Dec. 1987 p 18-24 (For primary document see N88-18150 10-51)
Avail: NTIS HC A07/MF A01

The effect of space flight factors, particularly radiation, on Artemia salina cysts, tobacco and rice seeds (embryos and caryopses) was investigated. Artemia salina cysts showed no significant deviation in response to this exposure. Minor changes in certain cyst groups were related to their packing, humidity, and preirradiation level. Tobacco seeds exhibited a higher frequency of somatic and morphological changes that were independent of their packing arrangement. Rice seeds developed no changes that could be associated with space flight effects. The changes seen are considered in relation to the radiation dose absorbed. The results obtained in different space experiments are discussed. Author

N88-18155# Joint Publications Research Service, Arlington, Va.
INVESTIGATION OF GENETIC STRUCTURES OF RAT GERM CELLS FOLLOWING FLIGHT ABOARD COSMOS-1514 BIOSATELLITE DURING THEIR PRENATAL DEVELOPMENT
D. K. Benova *In its* JPRS Report: Science and Technology. USSR: Space Biology and Aerospace Medicine, v. 21, no. 6, Nov. - Dec. 1987 11 Mar. 1988 p 32-36 Transl. into ENGLISH from Kosmicheskaya Biologiya i Aviakosmicheskaya Meditsina

(Moscow, USSR), v. 21, no. 6, Nov. - Dec. 1987 p 24-27 (For primary document see N88-18150 10-51)
Avail: NTIS HC A07/MF A01

Male rats that were flown on Cosmos-1514 during their prenatal days 13 through 18 were investigated. The animals were sacrificed when they reached sexual maturity. Preparations were made of their testes for cytogenetic analysis: spermatocytes were at the stages of diakinesis-metaphase 1. The flown rates had 0.9 percent translocations while the ground-based synchronous controls showed 0.5 percent. Exposure to space flight factors in combination had a mutagenic effect on gonocytes. However, the adverse effect of microgravity per se was not demonstrated unambiguously.
Author

N88-18156# Joint Publications Research Service, Arlington, Va.
MORPHOLOGICAL AND FUNCTIONAL STATE OF THE HYPOTHALAMO-HYPOPHYSEAL NEUROSECRETORY SYSTEM OF RATS FLOWN ABOARD COSMOS-1667
Ye. I. Alekseyev *In its* JPRS Report: Science and Technology. USSR: Space Biology and Aerospace Medicine, v. 21, no. 6, Nov. - Dec. 1987 11 Mar. 1988 p 37-42 Transl. into ENGLISH from Kosmicheskaya Biologiya i Aviakosmicheskaya Meditsina (Moscow, USSR), v. 21, no. 6, Nov. - Dec. 1987 p 27-31 (For primary document see N88-18150 10-51)
Avail: NTIS HC A07/MF A01

Morphological and morphometric data were used for comparative analysis of changes in the major compartments of the hypothalamic-pituitary neurosecretory system of Cosmos-1667 experimental and control rats. The flown rats showed morphological signs of inhibited ADH production. This inhibition may facilitate fluid excretion and development of a new hydration level at an early stage of adaptation to microgravity. The enhanced ADH secretion from neurons of supraoptic nuclei of the hypothalamus and axons of the posterior pituitary may lead to water retention and compensation of water loss after return to Earth's gravity.
Author

N88-18157# Joint Publications Research Service, Arlington, Va.
INVESTIGATION OF RAT SKELETAL MUSCLES FOLLOWING SHORT-TERM SPACEFLIGHT ABOARD COSMOS-1667 BIOSATELLITE
Ye. I. IlyinaKakuyeva *In its* JPRS Report: Science and Technology. USSR: Space Biology and Aerospace Medicine, v. 21, no. 6, Nov. - Dec. 1987 11 Mar. 1988 p 43-49 Transl. into ENGLISH from Kosmicheskaya Biologiya i Aviakosmicheskaya Meditsina (Moscow, USSR), v. 21, no. 6, Nov. - Dec. 1987 p 31-35 (For primary document see N88-18150 10-51)
Avail: NTIS HC A07/MF A01

Using morphological and histochemical methods, skeletal muscles (soleus, gastrocnemius, quadriceps, and biceps) of Wistar-SPF rats flown for 7 days on Cosmos-1667 were investigated. The short-term exposure to microgravity led to muscle atrophy which primarily involved myofibers with a high level of oxidative metabolism and a low level of ATPase activity. The percentage composition of myofibers of different types remained unchanged. The soleus muscle showed the greatest changes which included both atrophic and dystrophic shifts. Muscle atrophy developed together with metabolic changes that resulted in glycogen accumulation and decreased SDH activity. After return to Earth's gravity microcirculation disorders were seen only in the soleus muscles.
Author

N88-18158# Joint Publications Research Service, Arlington, Va.
MORPHOLOGICAL STUDY OF EARLY CHANGES IN RAT BONES IN SIMULATED WEIGHTLESSNESS
A. S. Kaplanskiy, Z. F. Sakharova, Ye. I. IlyinaKakuyeva, and G. N. Durnova *In its* JPRS Report: Science and Technology. USSR: Space Biology and Aerospace Medicine, v. 21, no. 6, Nov. - Dec. 1987 11 Mar. 1988 p 50-54 Transl. into ENGLISH from Kosmicheskaya Biologiya i Aviakosmicheskaya Meditsina (Moscow, USSR), v. 21, no. 6, Nov. - Dec. 1987 p 36-39 (For primary document see N88-18150 10-51)
Avail: NTIS HC A07/MF A01

By histomorphometric methods tibial bones and lumbar vertebrae of rats exposed for 7 days to hypokinesia or head-down suspension were investigated. Both hypokinesia and suspension led to osteoporosis of the tibial metaphyseal spongiosa which was primarily induced by bone growth inhibition and probably by increased bone resorption. No signs of osteoporosis were seen in tibial diaphyses. In contrast to tibial bones, osteoporosis of the spongiosa of lumbar vertebrae was found only in hypokinetic rats. It is concluded that exposure to simulated microgravity early signs of osteoporosis occur in the tibial spongiosa and that changes in the spongy matter of tubular bones and vertebrae are similar and systemic. It is suggested that an acute stress-reaction in response to simulated microgravity plays a certain role in the development of osteoporosis.
Author

N88-18159# Joint Publications Research Service, Arlington, Va.
LIPID PEROXIDATION IN RAT TISSUES WITH EXPOSURE TO ANTIORTHOSTATIC HYPOKINESIA, EXERCISE AND IMMOBILIZATION STRESS
A. Ye. Zezerov, S. M. Ivanova, and A. S. Ushakov *In its* JPRS Report: Science and Technology. USSR: Space Biology and Aerospace Medicine, v. 21, no. 6, Nov. - Dec. 1987 11 Mar. 1988 p 55-61 Transl. into ENGLISH from Kosmicheskaya Biologiya i Aviakosmicheskaya Meditsina (Moscow, USSR), v. 21, no. 6, Nov. - Dec. 1987 p 39-43 (For primary document see N88-18150 10-51)
Avail: NTIS HC A07/MF A01

Lipid peroxidation in tissues of rats exposed to antiorthostatic hypokinesia (-15 deg) for 60 days, heavy-load exercise (swimming), and 2-hour immobilization was investigated polarographically. Antiorthostatic hypokinesia produced activation of free-radical lipid peroxidation in skeletal muscles, myocardium, and plasma which reached a peak on hypokinesia day 3 and remained elevated by day 60. Exercise and immobilization applied during hypokinesia led to an accumulation of endogenous lipid peroxidation products in skeletal muscles and in the heart, although in a lesser degree. It is postulated that during hypokinesia lipid peroxidation is most probably activated due to the following factors: increased activity of the hormonal component of the sympathicoadrenal system, accumulation of excessive quantities of free fatty acids, and reduced activity of antioxidant enzymes.
Author

N88-18160# Joint Publications Research Service, Arlington, Va.
ROLE OF CARBON DIOXIDE IN CORRECTION OF COAGULATION HEMOSTASIS UNDER HYPOXIC CONDITIONS
G. D. Pak and V. S. Svershkova *In its* JPRS Report: Science and Technology. USSR: Space Biology and Aerospace Medicine, v. 21, no. 6, Nov. - Dec. 1987 11 Mar. 1988 p 62-67 Transl. into ENGLISH from Kosmicheskaya Biologiya i Aviakosmicheskaya Meditsina (Moscow, USSR), v. 21, no. 6, Nov. - Dec. 1987 p 43-47 (For primary document see N88-18150 10-51)
Avail: NTIS HC A07/MF A01

In acute animal experiments coagulation hemostasis reactions and blood acid-base state were investigated when dogs were breathin hypoxis (10 percent O2) or hypoxic-hypercapnic (10 percent O2, 5 percent CO2) gas mixtures. When given the hypoxic mixture, activation of blood coagulation was accompanied by depression of anticoagulatory and fibrinolytic properties. These changes developed together with distinct hypoxemia, respiratory alkalosis, and secondary metabolic acidosis. When given the hypoxic-hypercapnic mixture, no hypercoagulation occurred which can be explained by higher (than on the hypoxic mixture) p sub a O2, lack of disorders in acid-base equilibrium, and in oxygen supply. It is believed that the ability of carbon dioxide to maintain relative normocoagulation when added to the hypoxic mixture is one of the factors that increase tolerance to hypoxia.
Author

N88-18161# Joint Publications Research Service, Arlington, Va.
EFFECT OF CARDIOACTIVE COMPOUNDS ON RAT MYOCARDIUM ACTOMYOSIN FOLLOWING EXPOSURE TO ACCELERATIONS
M. A. Kayfadzhyan and B. A. Tikunov *In its* JPRS Report: Science and Technology. USSR: Space Biology and Aerospace

Medicine, v. 21, no. 6, Nov. - Dec. 1987 11 Mar. 1988 p 68-72 Transl. into ENGLISH from Kosmicheskaya Biologiya i Aviakosmicheskaya Meditsina (Moscow, USSR), v. 21, no. 6 Nov. - Dec. 1987 p 47-49 (For primary document see N88-18150 10-51)
Avail: NTIS HC A07/MF A01

It was shown that during centrifugation the modulating effect of cardioactive compounds, particularly adrenalin and obsidan, varies in similarity to that of Ca ions. The reactivity of the native actomyosin complex of the heart of white rats to such agents declines during centrifugation. This may be associated with changes in regulatory protein components through which the modulating effect of the above compounds is mediated. Differences in the reactivity to adrenalin and obsidan that persist after 2-month readaptation can be attributed to the heterogeneous recovery of properties of individual subunits of regulatory proteins. Author

N88-18162# Joint Publications Research Service, Arlington, Va.
MORPHOLOGICAL MANIFESTATIONS OF PRIMATE ADAPTATION TO ORTHOGRADE STATICS AND WALKING ERECT
G. S. Belkaniya, Yu. N. Kurochkin, A. S. Rakhmanov, K. V. Simavonyan, V. A. Dartsmeliya, A. N. Demin, and V. Ye. Filenko *In its* JPRS Report: Science and Technology. USSR: Space Biology and Aerospace Medicine, v. 21, no. 6, Nov. - Dec. 1987 11 Mar. 1988 p 73-78 Transl. into ENGLISH from Kosmicheskaya Biologiya i Aviakosmicheskaya Meditsina (Moscow, USSR), v. 21, no. 6, Nov. - Dec. 1987 p 51-54 (For primary document see N88-18150 10-51)
Avail: NTIS HC A07/MF A01

Using lower primates (rhesus monkeys) who were experimentally transformed to bipeds, morphological signs of their musculoskeletal adaptation to the upright walking patterns were examined. It was found that the biped developed typical characteristics of the upright posture: complete erectness of the torse and legs and noticeable enhancement of lumbar lordosis. The maximum deviation of the lumbar arch in the bipeds (10.0 + or 0.8 mm) was significantly greater than in the controls (1.5 + or - 0.5 mm). This was accompanied by distinct hypertrophy of leg muscles, primarily extensors, and increased mineral density of the tibia (by 38 percent), fibule (by 14 percent), and metatarsus by 23 percent). This was also followed by slight hypotrophy of biceps and triceps muscles and the large muscle of the thorax. Forearm muscles and bone mineral content were unchanged. The data obtained gave evidence that the genetic program of orthograde statics and erect posture which is typical of the entire primate order can find phenotypical realization in lower primates. Author

N88-18163# Joint Publications Research Service, Arlington, Va.
EFFECT OF EXOGENOUS CARDIOSYNCHRONIZED COUNTERPULSATION ON HUMAN REGIONAL AND CENTRAL HEMODYNAMICS **c52**
Kh. Kh. Yarullin, T. D. Vasilyeva, and I. P. Neumyvakin *In its* JPRS Report: Science and Technology. USSR: Space Biology and Aerospace Medicine, v. 21, no. 6, Nov. - Dec. 1987 11 Mar. 1988 p 79-85 Transl. into ENGLISH from Kosmicheskaya Biologiya i Aviakosmicheskaya Meditsina (Moscow, USSR), v. 21, no. 6, Nov. - Dec. 1987 p 54-58 (For primary document see N88-18150 10-51)
Avail: NTIS HC A07/MF A01

Variations in regional and central hemodynamics of man under the influence of exogenous contrapulsation (ECP) were examined rheographically. In recumbent subjects, ECP increased cerebral pulse blood filling, particularly of the vertebrobasilar system. It appears that the significant increase of the tone of arterioles and veins may be important when it becomes necessary to correct cerebral circulation in the situations that may lead to brain ischemia. It was found that in the orthostatic tilt test ECP can be an effective tool for enhancing brain and lung blood supply and increasing stroke volume, cardiac output, and blood pressure. This may help maintain homeostasis and improve orthostatic tolerance. The observation that ECP may facilitate blood supply of the vitally important organs, specifically brain, enables us to recommend this procedure to be used at an early stage of readaptation after simulation or real space flights. Author

N88-18164# Joint Publications Research Service, Arlington, Va.
EFFECT OF OXYGEN INHALATION ON RESPIRATORY FUNCTION DURING EXERCISE AND EXPOSURE TO ADDED RESISTANCE TO RESPIRATION **c52**
I. S. Breslav, G. G. Isayev, and K. S. Rymzhanov *In its* JPRS Report: Science and Technology. USSR: Space Biology and Aerospace Medicine, v. 21, no. 6, Nov. - Dec. 1987 11 Mar. 1988 p 86-91 Transl. into ENGLISH from Kosmicheskaya Biologiya i Aviakosmicheskaya Meditsina (Moscow, USSR), v. 21, no. 6, Nov. - Dec. 1987 p 59-62 (For primary document see N88-18150 10-51)
Avail: NTIS HC A07/MF A01

Experiments were performed to investigate the effect of added resistance to inspiratory, expiratory, and inspirator-expiratory respiration on lung ventilation and P sub A CO2 during exercise when breathing air or oxygen. Increase of resistance to respiration, particularly inspiratory-expiratory, reduced the work induced growth of aggravated those shifts significantly. The adverse effect of hyperoxia on the respiration function when exercise was combined with added resistance to respiration seems to be associated with inhibition of the respiration center produced by the lack of hyperoxid simulations. Author

N88-18165# Joint Publications Research Service, Arlington, Va.
POLAR WORKER ADAPTABILITY TO ANTARCTIC HIGH ALTITUDES **c52**
A. A. Aydaraliyev, A. L. Maksimov, and T. B. Chernook *In its* JPRS Report: Science and Technology. USSR: Space Biology and Aerospace Medicine, v. 21, no. 6, Nov. - Dec. 1987 11 Mar. 1988 p 92-98 Transl. into ENGLISH from Kosmicheskaya Biologiya i Aviakosmicheskaya Meditsina (Moscow, USSR), v. 21, no. 6, Nov. - Dec. 1987 p 62-66 (For primary document see N88-18150 10-51)
Avail: NTIS HC A07/MF A01

The examinations were carried out during the 27th Soviet Antarctic expedition. Baseline data were collected before the departure of the test subjects to the Antarctic Region. Prior to their ascent to the high mountain area they were divided into two groups with a high and a low level of hypoxic tolerance in terms of the work capacity index calculated on the basis of standard bicycle ergometry tests. Heart rate, body temperature, and salivary content of sodium and potassium were measured 6 times a day at 4 hour intervals. The results obtained were treated by nonparametric tests. It was found that on adapttion day 30 the subjects with low hypoxic tolerance and nonspecific resistance developed changes in biorhythm amplitudes and phases and showed ultradian components with a 12 hour period. By contrast, the subjects with high hypoxic tolerance retained the ability to maintain circadian patterns. By the middle of the wintering time the circadian rhythms shifted towards ultradian components regardless of individual hypoxic tolerance. Author

N88-18166# Joint Publications Research Service, Arlington, Va.
EFFECT OF EXTERNAL ELECTROSTATIC FIELD ON CATECHOLAMINE SECRETION BY RAT ADRENALS
G. G. Artsruni, A. V. Zilfyan, N. R. Azgaldyan, and R. A. Dovlatyan *In its* JPRS Report: Science and Technology. USSR: Space Biology and Aerospace Medicine, v. 21, no. 6, Nov. - Dec. 1987 11 Mar. 1988 p 99-103 Transl. into ENGLISH from Kosmicheskaya Biologiya i Aviakosmicheskaya Meditsina (Moscow, USSR), v. 21, no. 6, Nov. - Dec. 1987 p 67-70 (For primary document see N88-18150 10-51)
Avail: NTIS HC A07/MF A01

Experimental rats were exposed to an electrostatic field of 200 kW/m for 1, 24, or 6 hours a day for 6 days. The effect of this exposure on the structure and function of adrenal chromaffin bodies and the concentraiton of catecholamines and their precursors in blood and adrenals was investigated. Using histochemical fluorescent microscopic and spectrofluorimetric

methods, it was found that the exposure may modify the structure and function of adrenal chromaffins and the concentration of catecholamines in blood and adrenals. These changes depended on the exposure time. An hour exposure activated the secretory apparatus of adrenal chromaffins and enhanced catecholamine secretion to blood. A 24-hour exposure led to an increase in the concentration of catecholamines in adrenals and blood and a change in the organ cytoangioarchitectonics. A 6 day fractionated exposure resulted in a decrease of catecholamines both in blood and adrenals. Author

N88-18167# Joint Publications Research Service, Arlington, Va.
TWO-DIMENSIONAL STATIC OTOLITH MODEL **c52**
A. V. Konrachuk and S. P. Sirenko *In its* JPRS Report: Science and Technology. USSR: Space Biology and Aerospace Medicine, v. 21, no. 6, Nov. - Dec. 1987 11 Mar. 1988 p 104-115 Transl. into ENGLISH from Kosmicheskaya Biologiya i Aviakosmicheskaya Meditsina (Moscow, USSR), v. 21, no. 6, Nov. - Dec. 1987 p 70-76 (For primary document see N88-18150 10-51)
Avail: NTIS HC A07/MF A01

A model of the otolith as a system with distributed parameters in which the otolith is described by a two-dimensional elastic plate fixed at its sides is presented. The behavior of the model in response to centrifugal and gravitational forces is discussed. Comparison of this model with experimental data yields the value of Young's module of the otolith membrane equal to 100 to 1000 dyne/sq cm. It is shown that deformations of different compartments of the otolith are dissimilar even for a homogeneous otolith membrane, depending on its configuration and orientation relative to the force vector. It is concluded that intralabyrinthine pressure may be the cause of original nonhomogeneous deformation of hairs in receptor cells at rest. Author

N88-18168# Joint Publications Research Service, Arlington, Va.
COMBINED EFFECT OF IONIZING RADIATION AND ALTERED GAS ATMOSPHERE ON CENTRAL NERVOUS SYSTEM **c52**
B. I. Davydov, I. B. Ushakov, and V. P. Fedorov *In its* JPRS Report: Science and Technology. USSR: Space Biology and Aerospace Medicine, v. 21, no. 6, Nov. - Dec. 1987 11 Mar. 1988 p 116-125 Transl. into ENGLISH from Kosmicheskaya Biologiya i Aviakosmicheskaya Meditsina (Moscow, USSR), v. 21, no. 6, Nov. - Dec. 1987 p 76-83 (For primary document see N88-18150 10-51)
Avail: NTIS HC A07/MF A01

When the brain is exposed to ionizing radiation, marked changes may develop rather soon in its structures, which lead to neurological disorders, as a result of edema, as demonstrated in clinical practice and experimentally. However, the mechanisms of development of these disturbances were still not sufficiently investigated, while the feasibility of modifying radiation effects in the central nervous system (CNS) by changing the inhaled gas mixture is unjustifiably doomed to failure by some authors, and this is in fact in contradiction to the universal law of radiobiology, the oxygen effect, which was well-studied in other critical systems. At the present time, there is no unequivocal answer to the question of direction of modification of radiation effects in the CNS with use of an altered gas atmosphere. For this reason, 67 dogs of both sexes weighing 7 to 12 kg were studied. The results are examined.
Author

N88-18169# Joint Publications Research Service, Arlington, Va.
EFFECT OF HYPERCAPNIC-HYPOXIC TEST ON CARIORESPIRATORY PARAMETERS OF INDIVIDUALS WITH NEUROCIRCULATORY DYSTONIA **c52**
A. S. Nekhayev, V. D. Vlasov, V. K. Stepanov, and Yu. I. Andriyenko *In its* JPRS Report: Science and Technology. USSR: Space Biology and Aerospace Medicine, v. 21, no. 6, Nov. - Dec. 1987 11 Mar. 1988 p 126-130 Transl. into ENGLISH from Kosmicheskaya Biologiya i Aviakosmicheskaya Meditsina (Moscow, USSR), v. 21, no. 6, Nov. - Dec. 1987 p 83-86 (For primary document see N88-18150 10-51)
Avail: NTIS HC A07/MF A01

Twenty healthy men and twelve patients with hypertensive type neurocirculatory dystonia belonging to the flying personnel were examined. A hypercapnic-hypoxic mixture formed during rebreathing in a closed circuit without a CO2 absorber was breathed. In both groups this provocative test produced similar variations of most parameters under study. However in contrast to the healthy men, the hypertensive subjects showed a lower compensatory hyperventilation, a greater increase of blood pressure and cardiac output and a relatively small decrease of total peripheral resistance. Three test subjects displayed sinus arrhythmia. The time of test tolerance in the patients was on the average 20 percent shorter than in the healthy subjects. The changes can be viewed as an indication that the reserve capability of the cardiorespiratory system declines. The fact that the test is rapid, simple, and safe makes it possible to use it during regular medical monitoring of the flying personnel with functional disorders of the cardiovascular systems.
Author

N88-18170# Joint Publications Research Service, Arlington, Va.
OXIDATIVE ENZYME ACTIVITY IN HEALTHY SUBJECTS AND INDIVIDUALS WITH NEUROCIRCULATORY DYSTONIA DURING GRADED EXERCISE **c52**
Ye. G. Vetrova and I. A. Popova *In its* JPRS Report: Science and Technology. USSR: Space Biology and Aerospace Medicine, v. 21, no. 6, Nov. - Dec. 1987 11 Mar. 1988 p 131-135 Transl. into ENGLISH from Kosmicheskaya Biologiya i Aviakosmicheskaya Meditsina (Moscow, USSR), v. 21, no. 6, Nov. - Dec. 1987 p 86-89 (For primary document see N88-18150 10-51)
Avail: NTIS HC A07/MF A01

In response to controlled exercise (50 and 75 percent of maximum workload) malate dehyrogenase (MDH) and isocitrate dehydrogenase (ICDH) varied similarly in healthy men and in patients with hypertensive and hypotensive type neurocirculatory dystonia. However, in neurocirculatory dynstonia subjects MDH increase during exercise and normalizes during recovery develped slower than in healthy people. The MDH redistribution between mitochrondrial and cytoplasmic fractions remained unchanged.
Author

N88-18171# Joint Publications Research Service, Arlington, Va.
HEMODYNAMIC EFFECTS OF BETA-ADRENERGIC BLOCKING WITH OBSIDAN IN CLINOSTATIC AND ORTHOSTATIC POSITIONS **c52**
G. S. Belkaniya, M. V. Galustyan, V. A. Dartsmeliya, and A. N. Demin *In its* JPRS Report: Science and Technology. USSR: Space Biology and Aerospace Medicine, v. 21, no. 6, Nov. - Dec. 1987 11 Mar. 1988 p 136-143 Transl. into ENGLISH from Kosmicheskaya Biologiya i Aviakosmicheskaya Meditsina (Moscow, USSR), v. 21, no. 6, Nov. - Dec. 1987 p 90-94 (For primary document see N88-18150 10-51)
Avail: NTIS HC A07/MF A01

The objective was to determine the relevance of distinctions of circulatory regulation in clinostatic and orthostatic positions to hemodynamic effects of the beta-adrenergic blocker, obsidan.
Author

N88-18172# Joint Publications Research Service, Arlington, Va.
NEW BOOK ON METABOLIC ASPECTS OF SPACEFLIGHT STRESS **c52**
N. N. Demin and R. A. Tigranyan *In its* JPRS Report: Science and Technology. USSR: Space Biology and Aerospace Medicine, v. 21, no. 6, Nov. - Dec. 1987 11 Mar. 1988 p 144-145 Transl. into ENGLISH from Kosmicheskaya Biologiya i Aviakosmicheskaya Meditsina (Moscow, USSR), v. 21, no. 6, Nov. - Dec. 1987 p 95 (For primary document see N88-18150 10-51)
Avail: NTIS HC A07/MF A01

Although there is a vast literature already dealing with stress, in-depth investigation of expressly biochemical mechanisms of processes that develop under stress is only beginning. A comprehensive survey of the results of 12 years of rat experimentation is presented. The principle material consists of a detailed presentation of the results of studies of biochemical

parameters in the presence of stress-related changes in experimental animals flown in space for 18.5 to 22 dyas in 1973 to 1979 aboard 5 artificial earth satellites of the Cosmos series. B.G.

N88-18173# Oak Ridge National Lab., Tenn.
SCALING PHYSIOLOGICAL PHARMACOKINETIC MODELS BY PHYSIOLOGICAL TIME
R. C. Ward and C. C. Travis 1987 10 p Presented at the Society for Computer Simulation Multiconference, San Diego, Calif., 3 Feb. 1988
(Contract DE-AC05-84OR-21400)
(DE88-000335; CONF-880218-1) Avail: NTIS HC A02/MF A01

This paper shows that a multicompartment physiological pharmacokinetic model, used to account for inhalation exposure to volatile chlorohydrocarbons in mammalian species, can be made species-independent if chronological time is re-expressed in terms of physiological time. Physiological time is defined as chronological time divided by species body weight to the 1/4 power. We demonstrate the usefulness of this time scaling of the multicompartment physiological pharmacokinetic model by using it to model the inhalation of the volatile chlorinated hydrocarbon tetrachloroethylene in mice, rats, and humans. DOE

N88-18174*# National Aeronautics and Space Administration. Ames Research Center, Moffett Field, Calif.
NASA WORKSHOP ON BIOLOGICAL ADAPTATION
Emily Morey-Holton, ed. and Marc Tischler, ed. (Arizona Univ., Tucson.) Feb. 1988 105 p Workshop held 28-30 Apr. 1986
(NASA-TM-89468; A-87248; NAS 1.15:89468) Avail: NTIS HC A06/MF A01 CSCL 06B

A workshop was convened to review the current program in Space Biology Biological Adaptation Research and its objectives and to identify future research directions. Two research areas emerged from these deliberations: gravitational effects on structures and biomineralization and gravity affected regulatory mechanisms. The participants also recommended that research concentrate on rapidly growing animals, since gravity effects may be more pronounced during growth and development. Both research areas were defined and future research directions were identified. The recommendations of the workshop will assist the Life Sciences Division of NASA in it assessment and long-range planning of these areas of space biology. Equally important, the workshop was intended to stimulate thought and research among those attending so that they would, in turn, interest, excite, and involve other members of the academic community in research efforts relevant to these programs. Author

N88-18175*# Lockheed Engineering and Management Services Co., Inc., Washington, D.C.
USSR SPACE LIFE SCIENCES DIGEST, ISSUE 15
Lydia Razran Hooke, ed., Ronald Teeter, ed., Victoria Garshnek, ed., and Joseph Rowe, ed. (Library of Congress, Washington, D. C.) Mar. 1988 120 p
(Contract NASw-4292)
(NASA-CR-3922(18); NAS 1.26:3922(18)) Avail: NTIS HC A06/MF A01 CSCL 06B

This is the 15th issue of NASA's USSR Space Life Sciences Digest. It contains abstracts of 59 papers published in Russian language periodicals or presented at conferences and of two new Soviet monographs. Selected abstracts are illustrated with figures and tables from the original. An additional feature is a review of a conference devoted to the physiology of extreme states. The abstracts included in this issue have been identified as relevant to 29 areas of space biology and medicine. These areas are adaptation, biological rhythms, biospherics, body fluids, botany, cardiovascular and respiratory systems, endocrinology, enzymology, equipment and instrumentation, exobiology, genetics, habitability and environment effects, human performance, immunology, life support systems, mathematical modeling, metabolism, microbiology, musculoskeletal system, neurophysiology, nutrition, operational medicine, perception, personnel selection, psychology, radiobiology, reproductive biology, and space biology and medicine. Author

N88-17706*# City Coll. of the City Univ. of New York. Dept. of Science.
DROSOPHILA GEOTAXIS AS A TOOL FOR THE STUDY OF AGING
Edgar M. Schnebel, R. Nicholas Hoffmann, and Joe Grossfield *In* NASA. Goddard Space Flight Center, The 1987 Get Away Special Experimenter's Symposium Feb. 1988 p 107-113 (For primary document see N88-17691 10-12)
Avail: NTIS HC A08/MF A01 CSCL 06B

52 AEROSPACE MEDICINE

Includes physiological factors; biological effects of radiation; and effects of weightlessness on man and animals.

N88-18176# Cranfield Inst. of Tech., Bedford (England). Applied Psychology Unit.
CARDIOVASCULAR AND SUBJECTIVE MEASURES OF TASK DEMAND IN A LOW WORKLOAD MONITORING TASK Summary Report
Carole D. Braby Sep. 1987 24 p
(Rept-8804; ISBN-0-947767-84-3) Avail: NTIS HC A03/MF A01

A study was conducted in response to a general lack of research into the assessment of the workload which is experienced by the pilot at low levels of task demand. Four existing indices of workload were investigated regarding their sensitivity to two low level task demand situations, i.e., low demand and very low demand. The indices include: (1) The Bedford Workload scale; (2) A five point Alertness scale; (3) Heart rate - measured as the mean inter-beat interval; and (4) Heart rate variability - measured as the standard deviation of the inter-beat interval. A further multidimensional subjective scale which was developed during the study was also employed. This scale consisted of 30 adjectives and phrases which describe feelings of frustration, boredom, and fatigue. Author

N88-18177*# National Aeronautics and Space Administration. John F. Kennedy Space Center, Cocoa Beach, Fla.
RELATIONSHIPS BETWEEN CORONARY HEART DISEASE RISK FACTORS AND SERUM IONIZED CALCIUM IN KENNEDY SPACE CENTER COHORT
Lisa Ann Goodwin, Mary Anne Bassett Frey, Marion P. Merz, and William R. Alford (Bionetics Corp., Cocoa Beach, Fla.) Aug. 1987 24 p
(Contract NAS10-10285)
(NASA-TM-100979; NAS 1.15:100979) Avail: NTIS HC A03/MF A01 CSCL 06P

Kennedy Space Center (KSC) employees are reported to be at high risk for coronary heart disease (CHD). Risk factors for CHD include high serum total cholesterol levels, low levels of high-density lipoprotein cholesterol (HDLC), elevated triglyceride, smoking, inactivity, high blood pressure, being male, and being older. Higher dietary and/or serum calcium Ca(++) may be related to a lower risk for CHD. Fifty men and 37 women participated. Subjects were tested in the morning after fasting 12 hours. Information relative to smoking and exercise habits was obtained; seated blood pressures were measured; and blood drawn. KCS men had higher risk values than KCS women as related to HDLC, triglycerides, systolic blood pressure, and diastolic blood pressure. Smoking and nonsmoking groups did not differ for other risk factors or for serum Ca(++) levels. Exercise and sedentary groups differed in total cholesterol and triglyceride levels. Serum Ca(++) levels were related to age, increasing with age in the sedentary group and decreasing in the exercisers, equally for men and women. It is concluded that these relationships may be significant to the risk of CHD and/or the risk of bone demineralization in an aging population. Author

N88-18178# Technische Hogeschool Twente, Enschede (Netherlands).
INTERACTIONS OF CULTURED HUMAN ENDOTHELIAL CELLS WITH POLYMERIC SURFACES Ph.D. Thesis
P. B. vanWachem Feb. 1987 147 p
(PB88-112255) Avail: NTIS HC A07/MF A01 CSCL 06P

The aim of the study is to elucidate the mechanisms involved in the in vitro interactions between seeded cultured human endothelial cells (EC) and polymers with different surface properties. Adhesion, spreading, proliferation, and several other functions of cultured human EC have been investigated and related to the surface properties of the polymer substrates. GRA

N88-18179# Helsinki Univ. of Technology, Espoo (Finland). Low Temperature Lab.
REALISTIC CONDUCTIVITY GEOMETRY MODEL OF THE HUMAN HEAD FOR INTERPRETATION OF NEUROMAGNETIC DATA
M. S. Haemaelaeinen and J. Sarvas Jul. 1987 24 p
(PB88-112230; TKK-F-A614; ISBN-951-754-152-X) Avail: NTIS HC A03/MF A01 CSCL 06P

The computational and practical aspects of a realistically shaped multilayer model for the conductivity geometry of the human head are discussed. A novel way to handle the numerical difficulties caused by the presence of the poorly conducting skull is presented. With this method, both the potential on the surface of the head and the magnetic field outside the head can be computed accurately. The procedure was tested with the multilayer sphere model, for which analytical expressions are available. The method is then applied to a realistically shaped head model, and it is numerically shown that for the computation of B vector, produced by cerebral current sources, it is sufficient to consider a brain shaped homogeneous conductor only, since the secondary currents on the outer interfaces give only a negligible contribution to the magnetic field outside the head. Comparisons with the sphere model are also included to pinpoint areas where the homogeneous conductor model provides essential improvements in the calculation of the magnetic field outside the head. Author

N88-18180* National Aeronautics and Space Administration, Washington, D.C.
AEROSPACE MEDICINE AND BIOLOGY: A CUMULATIVE INDEX TO A CONTINUING BIBLIOGRAPHY (SUPPLEMENT 306)
Jan. 1988 210 p
(NASA-SP-7011(306); NAS 1.21:7011(306)) Avail: NTIS HC A10 CSCL 06E

This publication is a cumulative index to the abstracts contained in the Supplements 294 through 305 of Aerospace Medicine and Biology: A Continuing Bibliography. It includes seven indexes - subject, personal author, corporate source, foreign technology, contract number, report number, and accession number. Author

N88-18181*# National Aeronautics and Space Administration, Washington, D.C.
CERTAIN ASPECTS OF HUMAN METABOLISM DURING SPACEFLIGHTS OF VARYING DURATION
A. I. Grigoryev, I. A. Popova, and A. S. Ushakov Mar. 1988 36 p Transl. into ENGLISH of Nekotoryye Storony Obmena Veshchestv Cheloveka v Kosmicheskikh Poletakh Razlichnoy Prodolzhitel'nosti presented at 1st Meeting of the Joint Soviet-American Working Group on Space Biology, 1987 Meeting held in Nalchik, USSR, 2-11 Aug. 1987 Transl. by Scientific Translation Service, Santa Barbara, Calif.
(Contract NASw-4307)
(NASA-TT-20215; NAS 1.77:20215) Avail: NTIS HC A03/MF A01 CSCL 06P

A comparative analysis is made of hormone reactions after short and long term spaceflights. Endocrinological indicators from venous blood and daily urine samples of cosmonauts completing flights lasting from 7 to 237 days were examined. No pathological indicators were found in the metabolic shifts in the erythrocytes and disruption of the functional state of their membranes. Author

N88-18182*# National Aeronautics and Space Administration, Washington, D.C.
BASIC RESULTS OF MEDICAL STUDIES DURING PROLONGED MANNED FLIGHTS ON-BOARD THE SALYUT-7/SOYUZ-T ORBITAL COMPLEX
Mar. 1988 64 p Transl. into ENGLISH of conference paper presented at the 1st Joint Soviet-American Working Group on Space Biology and Medicine, 1987 Meeting held in Nalchik, USSR, 2-11 Aug. 1987 Transl. by Scientific Translation Service, Santa Barbara, Calif.
(Contract NASw-4307)
(NASA-TT-20217; NAS 1.77:20217) Avail: NTIS HC A04/MF A01 CSCL 06S

From 1982 through 1986 six extended flights (from 65 to 237 days) were carried out in the Salyut-7/Soyuz-T orbital complex by the principal crews, and five short-term flights (8 to 12 days) by visiting crews. During these flights, a broad series of medical studies was performed, their greatest extent during the longest flight (237 days), with the participation of a cosmonaut-doctor. The medical studies were aimed at obtaining additional information and new data on the reactions of the body's basic systems during a prolonged state of weightlessness. Author

N88-18183* National Aeronautics and Space Administration, Washington, D.C.
AEROSPACE MEDICINE AND BIOLOGY: A CONTINUING BIBLIOGRAPHY WITH INDEXES (SUPPLEMENT 308)
Mar. 1988 65 p
(NASA-SP-7011(308); NAS 1.21:7011(308)) Avail: NTIS HC A04; NTIS standing order as PB88-912300, $9.00 domestic, $18.00 foreign CSCL 06E

This bibliography lists 175 reports, articles, and other documents introduced into the NASA scientific and technical information system in February, 1988. Author

N88-18184# JAYCOR, San Diego, Calif.
MODELING OF THE NON-AUDITORY RESPONSE TO BLAST OVERPRESSURE Annual Report, 15 Aug. 1985 - 14 Aug. 1986
James H. Stuhmiller 1 Feb. 1987 9 p
(Contract DAMD17-85-C-5238; DA Proj. 3E1-62777-A-878)
(AD-A187397) Avail: NTIS HC A02/MF A01 CSCL 06N

Mathematical models of the physical processes that cause blast injury are developed so that the results of these tests using animals in simple blast environments can be safely translated to estimating hazard to man exposed to blast both in the free field and within enclosures. This project builds on earlier work performed to develop models of the mechanics of the thorax and lung exposed to simple blast waves. The scope of interest has been expanded to include the lung exposed to simple blast waves. The scope of interest has been expanded to include the lung, and gastro-intestinal tract, the upper respiratory tract, and the tympanic organs, and to include a more extensive investigation of the magnitude and distribution of loading under a wider range of blast situations. The report covers the first year of the contract. Effort was concentrated in formulating a specific mathematical approach to each organ system, collecting and analyzing data from previous field tests, and developing models that can provide preliminary Damage Risk Criteria for the most susceptible organ system, the upper respiratory tract. GRA

N88-18185# Southern Methodist Univ., Dallas, Tex.
THE PRECISION OF LIMITS ON BODILY FLUIDS WHEN USING BETA-EXPECTATION INNER TOLERANCE LIMITS
Y.-M. Chou and D. B. Owen 15 Oct. 1987 10 p
(Contract N00014-84-K-0146)
(AD-A187966; SMU-2-288-87) Avail: NTIS HC A02/MF A01 CSCL 06D

A solution is discussed to the problem of setting limits for the normal range for a bodily fluid based on a sample of observations on that bodily fluid. The procedure being considered is known as beta-expectation inner tolerance limits. Also a new criterion is proposed for assessing the precision of these limits for various sample sizes. GRA

N88-18186# Naval Aerospace Medical Research Lab., Pensacola, Fla.
THE ACCOMMODATIVE STATUS IN THE DARK OF US NAVY FIGHTER PILOTS Interim Report
Leonard A. Temme and E. L. Ricks Mar. 1987 31 p
(AD-A188188; NAMRL-1332) Avail: NTIS HC A03/MF A01
CSCL 05F

Visual accommodation of 172 naval aviators in the dark was measured and compared to their most recent night carrier landing scores and the average distance at which an adversary aircraft was first sighted during air combat maneuver training. No significant correlations were found between the accommodation measures and either measure of operational performance. Reasons for this result are discussed. Accommodation measures in the aviator sample in the dark are compared to measures made in samples of college students reported in the literature. The aviator sample is significantly less myopic than the student sample. For example, only 6 percent of the students have as little myopia as the average naval aviator. This dramatic difference in accommodation could result from either training or some set of selection factors. Possible reasons for this finding and its significance for the Navy are discussed. GRA

N88-18123# Joint Publications Research Service, Arlington, Va.
MEDICAL AND PSYCHOLOGICAL PROBLEMS OF ASSURING FLIGHT SAFETY UNDER PRESENT CONDITIONS
S. A. Bugrov and V. A. Ponomarenko *In its* JPRS Report: Science and Technology. USSR: Space Biology and Aerospace Medicine, v. 21, no. 5, Sep. - Oct. 1987 25 Feb. 1988 p 1-8 Transl. into ENGLISH from Kosmicheskaya Biologiya i Aviakosmicheskaya Meditsina (Moscow, USSR), v. 21, no. 5, Sep. - Oct. 1987 p 4-10 (For primary document see N88-18122 10-51)
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N88-18131# Joint Publications Research Service, Arlington, Va.
ROLE OF OPTOKINETIC STIMULATION IN VESIBULOSPINAL REFLEXES
Yu. V. Krylov, V. V. Ivanov, A. A. Podshivalov, and V. V. Zaritskiy *In its* JPRS Report: Science and Technology. USSR: Space Biology and Aerospace Medicine, v. 21, no. 5, Sep. - Oct. 1987 25 Feb. 1988 p 50-56 Transl. into ENGLISH from Kosmicheskaya Biologiya i Aviakosmicheskaya Meditsina (Moscow, USSR), v. 21, no. 5, Sep. - Oct. 1987 p 36-41 (For primary document see N88-18122 10-51)
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N88-18132# Joint Publications Research Service, Arlington, Va.
MEMBRANE MODEL OF CUPULA OR VESTIBULAR SEMICIRCULAR CANALS
A. V. Kondrachuk, A. A. Shipov, and S. P. Sirenko *In its* JPRS Report: Science and Technology. USSR: Space Biology and Aerospace Medicine, v. 21, no. 5, Sep. - Oct. 1987 25 Feb. 1988 p 57-67 Transl. into ENGLISH from Kosmicheskaya Biologiya i Aviakosmicheskaya Meditsina (Moscow, USSR), v. 21, no. 5, Sep. - Oct. 1987 p 41-47 (For primary document see N88-18122 10-51)
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N88-18133# Joint Publications Research Service, Arlington, Va.
INVESTIGATION OF EFFECTS OF SHORT-TERM EXPOSURE TO HIGH CONCENTRATIONS OF CARBON MONOXIDE ON OPERATOR'S PSYCHOPHYSIOLOGICAL FUNCTIONS
V. Ye. Yastrebov, V. V. Kustov, and S. M. Razinkin *In its* JPRS Report: Science and Technology. USSR: Space Biology and Aerospace Medicine, v. 21, no. 5, Sep. - Oct. 1987 25 Feb. 1988 p 68-72 Transl. into ENGLISH from Kosmicheskaya Biologiya i Aviakosmicheskaya Meditsina (Moscow, USSR), v. 21, Sep. - Oct. 1987 p 47-50 (For primary document see N88-18122 10-51)
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N88-18134# Joint Publications Research Service, Arlington, Va.
HUMAN BLOOD GLUTAMIC ACID LEVEL WITH EXPOSURE TO HIGH AMBIENT CONCENTRATIONS OF AMMONIA
V. P. Savina, T. F. Vlasova, and Ye. B. Miroshnikova *In its* JPRS Report: Science and Technology. USSR: Space Biology and Aerospace Medicine, v. 21, no. 5, Sep. - Oct. 1987 25 Feb. 1988 p 73-77 Transl. into ENGLISH from Kosmicheskaya Biologiya i Aviakosmicheskaya Meditsina (Moscow, USSR), v. 21, no. 5, Sep. - Oct. 1987 p 50-52 (For primary document see N88-18122 10-51)
Copyright Avail: NTIS HC A08/MF A01

N88-18136# Joint Publications Research Service, Arlington, Va.
FORECASTING COMPLICATIONS OF CARDIOVASCULAR DISEASE IN FLIGHT PERSONNEL
G. L. Strongin, A. S. Turetskaya, B. L. Gelman, and O. N. Rodionov *In its* JPRS Report: Science and Technology. USSR: Space Biology and Aerospace Medicine, v. 21, no. 5, Sep. - Oct. 1987 25 Feb. 1988 p 84-90 Transl. into ENGLISH from Kosmicheskaya Biologiya i Aviakosmicheskaya Meditsina (Moscow, USSR), v. 21, no. 5, Sep. - Oct. 1987 p 57-62 (For primary document see N88-18122 10-51)
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N88-18137# Joint Publications Research Service, Arlington, Va.
EVALUATION OF SPARE ROOM IN CEREBROSPINAL SYSTEM USING NONINVASIVE METHODS
L. G. Simonov, A. K. Tsaturyan, A. S. Saribekyan, and L. G. Shmidt *In its* JPRS Report: Science and Technology. USSR: Space Biology and Aerospace Medicine, v. 21, no. 5, Sep. - Oct. 1987 25 Feb. 1988 p 91-95 Transl. into ENGLISH from Kosmicheskaya Biologiya i Aviakosmicheskaya Meditsina (Moscow, USSR), v. 21, no. 5, Sep. - Oct. 1987 p 62-65 (For primary document see N88-18122 10-51)
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N88-18138# Joint Publications Research Service, Arlington, Va.
ISOTOPE METHODS OF DETERMINING DISTRIBUTION AND MOVEMENT OF BLOOD IN THE BODY
V. I. Lobachik, V. N. Korsunskiy, V. I. Popov, S. V. Abrosimov, V. V. Zhidkov, and V. A. Andretsov *In its* JPRS Report: Science and Technology. USSR: Space Biology and Aerospace Medicine, v. 21, no. 5, Sep. - Oct. 1987 25 Feb. 1988 p 96-100 Transl. into ENGLISH from Kosmicheskaya Biologiya i Aviakosmicheskaya Meditsina (Moscow, USSR), v. 21, no. 5, Sep. - Oct. 1987 p 65-67 (For primary document see N88-18122 10-51)
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N88-18139# Joint Publications Research Service, Arlington, Va.
MUSCLE PRESERVATION IN THE STUDY OF BIOENERGETIC EFFECTS OF HYPOKINESIA
E. S. Mailyan and L. B. Buravkova *In its* JPRS Report: Science and Technology. USSR: Space Biology and Aerospace Medicine, v. 21, no. 5, Sep. - Oct. 1987 25 Feb. 1988 p 101-104 Transl. into ENGLISH from Kosmicheskaya Biologiya i Aviakosmicheskaya Meditsina (Moscow, USSR), v. 21, no. 5, Sep. - Oct. 1987 p 67-70 (For primary document see N88-18122 10-51)
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N88-18143# Joint Publications Research Service, Arlington, Va.
COMPARATIVE EVALUATION OF ORTHOSTATIC STABILITY FOLLOWING IMMERSION IN HORIZONTAL AND VERTICAL POSITIONS
A. Yu. Modin *In its* JPRS Report: Science and Technology. USSR: Space Biology and Aerospace Medicine, v. 21, no. 5, Sep. - Oct. 1987 25 Feb. 1988 p 120-122 Transl. into ENGLISH from Kosmicheskaya Biologiya i Aviakosmicheskaya Meditsina (Moscow, USSR), v. 21, no. 5, Sep. - Oct. 1987 p 77-79 (For primary document see N88-18122 10-51)
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N88-18145# Joint Publications Research Service, Arlington, Va.
EFFECT OF ANTIORTHOSTATIC POSITION AND DIFFERENT ILLUMINATION ON SENSITIVITY OF SKIN IN UPPER HALF OF THE BODY TO ULTRAVIOLET RADIATION
I. V. Zubkova, L. V. Gutorova, and N. Ye. Panferova *In its* JPRS Report: Science and Technology. USSR: Space Biology and Aerospace Medicine, v. 21, no. 5, Sep. - Oct. 1987 25 Feb. 1988 p 127-129 Transl. into ENGLISH from Kosmicheskaya Biologiya i Aviakosmicheskaya Meditsina (Moscow, USSR), v. 21, no. 5, Sep. - Oct. 1987 p 81-82 (For primary document see N88-18122 10-51)
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N88-18147# Joint Publications Research Service, Arlington, Va.
SECOND ALL-UNION CONFERENCE ON PHYSIOLOGY OF EXTREME STATES AND INDIVIDUAL PROTECTION OF MAN
S. G. Salivon *In its* JPRS Report: Science and Technology. USSR: Space Biology and Aerospace Medicine, v. 21, no. 5, Sep. - Oct. 1987 25 Feb. 1988 p 138-143 Transl. into ENGLISH from Kosmicheskaya Biologiya i Aviakosmicheskaya Meditsina (Moscow, USSR), v. 21, no. 5, Sep. - Oct. 1987 p 86-89 (For primary document see N88-18122 10-51)
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N88-18151# Joint Publications Research Service, Arlington, Va.
PRESENT STAGE OF SPACE MEDICINE
B. S. Alyakrinskiy *In its* JPRS Report: Science and Technology. USSR: Space Biology and Aerospace Medicine, v. 21, no. 6, Nov. - Dec. 1987 11 Mar. 1988 p 1-9 Transl. into ENGLISH from Koshmicheskaya Biologiya i Aviakosmicheskaya Meditsina (Moscow, USSR), v. 21, no. 6, Nov. - Dec. 1987 p 3-10 (For primary document see N88-18150 10-51)
Avail: NTIS HC A07/MF A01

N88-18152# Joint Publications Research Service, Arlington, Va.
RESULTS OF LONG-TERM ELECTROCARDIOGRAPHIC MONITORING OF COSMONAUTS
Ye. M. Romanov, N. P. Artamonova, Z. A. Golubchikova, A. F. Zavadovskiy, M. M. Korotayev, V. R. Lyamin, and V. D. Turbasov *In its* JPRS Report: Science and Technology. USSR: Space Biology and Aerospace Medicine, v. 21, no. 6, Nov. - Dec. 1987 11 Mar. 1988 p 10-16 Transl. into ENGLISH from Kosmicheskaya Biologiya i Aviakosmicheskaya Meditsina (Moscow, USSR), v. 21, no. 6, Nov. - Dec. 1987 p 10-14 (For primary document see N88-18150 10-51)
Avail: NTIS HC A07/MF A01

N88-18153# Joint Publications Research Service, Arlington, Va.
IMPROVEMENT OF HUMAN TOLERANCE TO HEAD-PELVIS (+Gz) ACCELERATIONS BY INCREASING HYDRATION
A. R. Kotovskaya, S. Baranski, D. Gembizka, M. Voitkowjak, I. F. VilVilyams, and N. I. Kokova *In its* JPRS Report: Science and Technology. USSR: Space Biology and Aerospace Medicine, v. 21, no. 6, Nov. - Dec. 1987 11 Mar. 1988 p 17-22 Transl. into ENGLISH from Kosmicheskaya Biologiya i Aviakosmicheskaya Meditsina (Moscow, USSR), v. 21, no. 6, Nov. - Dec. 1987 p 14-18 (For primary document see N88-18150 10-51)
Avail: NTIS HC A07/MF A01

N88-18163# Joint Publications Research Service, Arlington, Va.
EFFECT OF EXOGENOUS CARDIOSYNCHRONIZED COUNTERPULSATION ON HUMAN REGIONAL AND CENTRAL HEMODYNAMICS
Kh. Kh. Yarullin, T. D. Vasilyeva, and I. P. Neumyvakin *In its* JPRS Report: Science and Technology. USSR: Space Biology and Aerospace Medicine, v. 21, no. 6, Nov. - Dec. 1987 11 Mar. 1988 p 79-85 Transl. into ENGLISH from Kosmicheskaya Biologiya i Aviakosmicheskaya Meditsina (Moscow, USSR), v. 21, no. 6, Nov. - Dec. 1987 p 54-58 (For primary document see N88-18150 10-51)
Avail: NTIS HC A07/MF A01

N88-18164# Joint Publications Research Service, Arlington, Va.
EFFECT OF OXYGEN INHALATION ON RESPIRATORY FUNCTION DURING EXERCISE AND EXPOSURE TO ADDED RESISTANCE TO RESPIRATION
I. S. Breslav, G. G. Isayev, and K. S. Rymzhanov *In its* JPRS Report: Science and Technology. USSR: Space Biology and Aerospace Medicine, v. 21, no. 6, Nov. - Dec. 1987 11 Mar. 1988 p 86-91 Transl. into ENGLISH from Kosmicheskaya Biologiya i Aviakosmicheskaya Meditsina (Moscow, USSR), v. 21, no. 6, Nov. - Dec. 1987 p 59-62 (For primary document see N88-18150 10-51)
Avail: NTIS HC A07/MF A01

N88-18165# Joint Publications Research Service, Arlington, Va.
POLAR WORKER ADAPTABILITY TO ANTARCTIC HIGH ALTITUDES
A. A. Aydaraliyev, A. L. Maksimov, and T. B. Chernook *In its* JPRS Report: Science and Technology. USSR: Space Biology and Aerospace Medicine, v. 21, no. 6, Nov. - Dec. 1987 11 Mar. 1988 p 92-98 Transl. into ENGLISH from Kosmicheskaya Biologiya i Aviakosmicheskaya Meditsina (Moscow, USSR), v. 21, no. 6, Nov. - Dec. 1987 p 62-66 (For primary document see N88-18150 10-51)
Avail: NTIS HC A07/MF A01

N88-18167# Joint Publications Research Service, Arlington, Va.
TWO-DIMENSIONAL STATIC OTOLITH MODEL
A. V. Konrachuk and S. P. Sirenko *In its* JPRS Report: Science and Technology. USSR: Space Biology and Aerospace Medicine, v. 21, no. 6, Nov. - Dec. 1987 11 Mar. 1988 p 104-115 Transl. into ENGLISH from Kosmicheskaya Biologiya i Aviakosmicheskaya Meditsina (Moscow, USSR), v. 21, no. 6, Nov. - Dec. 1987 p 70-76 (For primary document see N88-18150 10-51)
Avail: NTIS HC A07/MF A01

N88-18168# Joint Publications Research Service, Arlington, Va.
COMBINED EFFECT OF IONIZING RADIATION AND ALTERED GAS ATMOSPHERE ON CENTRAL NERVOUS SYSTEM
B. I. Davydov, I. B. Ushakov, and V. P. Fedorov *In its* JPRS Report: Science and Technology. USSR: Space Biology and Aerospace Medicine, v. 21, no. 6, Nov. - Dec. 1987 11 Mar. 1988 p 116-125 Transl. into ENGLISH from Kosmicheskaya Biologiya i Aviakosmicheskaya Meditsina (Moscow, USSR), v. 21, no. 6, Nov. - Dec. 1987 p 76-83 (For primary document see N88-18150 10-51)
Avail: NTIS HC A07/MF A01

N88-18169# Joint Publications Research Service, Arlington, Va.
EFFECT OF HYPERCAPNIC-HYPOXIC TEST ON CARIORESPIRATORY PARAMETERS OF INDIVIDUALS WITH NEUROCIRCULATORY DYSTONIA
A. S. Nekhayev, V. D. Vlasov, V. K. Stepanov, and Yu. I. Andriyenko *In its* JPRS Report: Science and Technology. USSR: Space Biology and Aerospace Medicine, v. 21, no. 6, Nov. - Dec. 1987 11 Mar. 1988 p 126-130 Transl. into ENGLISH from Kosmicheskaya Biologiya i Aviakosmicheskaya Meditsina (Moscow, USSR), v. 21, no. 6, Nov. - Dec. 1987 p 83-86 (For primary document see N88-18150 10-51)
Avail: NTIS HC A07/MF A01

N88-18170# Joint Publications Research Service, Arlington, Va.
OXIDATIVE ENZYME ACTIVITY IN HEALTHY SUBJECTS AND INDIVIDUALS WITH NEUROCIRCULATORY DYSTONIA DURING GRADED EXERCISE
Ye. G. Vetrova and I. A. Popova *In its* JPRS Report: Science and Technology. USSR: Space Biology and Aerospace Medicine, v. 21, no. 6, Nov. - Dec. 1987 11 Mar. 1988 p 131-135 Transl. into ENGLISH from Kosmicheskaya Biologiya i Aviakosmicheskaya Meditsina (Moscow, USSR), v. 21, no. 6, Nov. - Dec. 1987 p 86-89 (For primary document see N88-18150 10-51)
Avail: NTIS HC A07/MF A01

N88-18171# Joint Publications Research Service, Arlington, Va.
HEMODYNAMIC EFFECTS OF BETA-ADRENERGIC BLOCKING WITH OBSIDAN IN CLINOSTATIC AND ORTHOSTATIC POSITIONS
G. S. Belkaniya, M. V. Galustyan, V. A. Dartsmeliya, and A. N. Demin *In its* JPRS Report: Science and Technology. USSR: Space Biology and Aerospace Medicine, v. 21, no. 6, Nov. - Dec. 1987 11 Mar. 1988 p 136-143 Transl. into ENGLISH from Kosmicheskaya Biologiya i Aviakosmicheskaya Meditsina (Moscow, USSR), v. 21, no. 6, Nov. - Dec. 1987 p 90-94 (For primary document see N88-18150 10-51)
Avail: NTIS HC A07/MF A01

N88-18172# Joint Publications Research Service, Arlington, Va.
NEW BOOK ON METABOLIC ASPECTS OF SPACEFLIGHT STRESS
N. N. Demin and R. A. Tigranyan *In its* JPRS Report: Science and Technology. USSR: Space Biology and Aerospace Medicine, v. 21, no. 6, Nov. - Dec. 1987 11 Mar. 1988 p 144-145 Transl. into ENGLISH from Kosmicheskaya Biologiya i Aviakosmicheskaya Meditsina (Moscow, USSR), v. 21, no. 6, Nov. - Dec. 1987 p 95 (For primary document see N88-18150 10-51)
Avail: NTIS HC A07/MF A01

53 BEHAVIORAL SCIENCES

Includes psychological factors; individual and group behavior; crew training and evaluation; and psychiatric research.

N88-18187# Katholieke Universiteit, Nijmegen (Netherlands). Psychologisch Lab.
UNIDIMENSIONAL RASCH MODEL AND MULTIDIMENSIONAL DATA: AN ANALYTIC APPROACH
A. L. vandenWollenberg and J. M. Wit 15 Dec. 1986 30 p
(PB88-105861; Rept-86-MA-01) Avail: NTIS HC A03/MF A01
CSCL 05I

An analytic approach is given of the influence of multidimensionality on unidimensional measurement in the context of the Rasch model. For a linear compensatory multidimensional data structure, the Pearson correlation is derived between the dominant latent trait, shared by all items, and the latent trait which results from the linear compensatory model. The correlation depends on the number of traits, the level of predominance of the dominant trait, the correlation among the traits and finally of the trait variances. Under some conditions the correlation between the dominant latent trait and the composite latent trait is .97 or higher. By means of Monte Carlo simulation studies it is demonstrated that the derived correlation is a good quantitative description of the influence of multidimensionality upon Rasch ability estimates. The correlation between the dominant latent trait and the estimated trait can be decomposed into two multiplicative components; the correlation between the dominant trait and the composite trait on the one hand and the correlation between the composite trait and the estimated trait on the other hand. The last correlation is looked upon as the index of reliability of the estimation. Author

N88-18188# Ohio State Univ., Columbus. Research Foundation.
PERCEPTION AND CONTROL OF SIMULATED SELF MOTION Final Report, Apr. 1983 - Mar. 1987
Dean H. Owen, Scott J. Freeman, Brian F. Zaff, and Lawrence Wolpert Nov. 1987 194 p
(Contract F33615-83-K-0038)
(AD-A187444; AFHRL-TR-87-16) Avail: NTIS HC A09/MF A01
CSCL 06D

This report includes three experiment sections. The first experiment tested sensitivity decreased with higher flow rates, and demonstrated that: (1) preview effects led to adaptation, (2) sensitivity decreased with higher flow rates, and (3) sensitivity increased with higher optical texture densities and fractional loss. The second and third experiments examined the perception and control of change in forward speed and altitude, respectively. Results from the former indicated that higher levels of fractional loss led to enhanced control of a consistent speed, whereas high flow and/or edge rates interfered with performance. The control of altitude change was similarly affected by the levels of fractional loss, but the negative effect of flow rate occurred only in conditions of descending flight. Theoretical implications for the ecological approach to the study of perception and control are discussed. GRA

N88-18189# Naval Personnel Research and Development Center, San Diego, Calif.
METHODS OF ELICITING INFORMATION FROM EXPERTS
David Meister Oct. 1987 27 p
(AD-A187468; NPRDC-TN-88-2) Avail: NTIS HC A03/MF A01
CSCL 05H

The biggest bottleneck in the development of expert systems is the problem of eliciting from experts the mechanisms responsible for their expertise. This report examines what is known about experts and suggests a number of ways of eliciting information from them. The literature suggests that the mechanisms of expertise represent deep-seated ways of conceptualizing and perceiving stimuli, and that these mechanisms must be differentiated from relatively superficial proceduralized rules, which make up most of what expert information consists of today. The goal of reproducing the expert's mental processes in a computer system appears unrealistic at present. The only way of determining that one has, in fact, tapped expertise is to build the expert system and evaluate its effectiveness. If it matches or surpasses human proficiency, one has incorporated human expertise into the system. GRA

N88-18146# Joint Publications Research Service, Arlington, Va.
DISCRETE ADAPTATION TO SENSORY CONFLICT
B. I. Polyakov *In its* JPRS Report: Science and Technology. USSR: Space Biology and Aerospace Medicine, v. 21, no. 5, Sep. - Oct. 1987 25 Feb. 1988 p 130-137 Transl. into ENGLISH from Kosmicheskaya Biologiya i Aviakosmicheskaya Meditsina (Moscow, USSR), v. 21, no. 5, Sep. - Oct. 1987 p 82-86 (For primary document see N88-18122 10-51)
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54 MAN/SYSTEM TECHNOLOGY AND LIFE SUPPORT

Includes human engineering; biotechnology; and space suits and protective clothing.

For related information see also *16 Space Transportation.*

N88-18190# Rockwell International Corp., Canoga Park, Calif.
INTERNATIONAL COOPERATIVE EFFORT TO ESTABLISH ASTM (AMERICAN SOCIETY FOR TESTING AND MATERIALS) STANDARDS FOR THE MEASUREMENT OF RADIATION DOSE FOR FOOD PROCESSING
H. Farrar, IV 1987 4 p Presented at the 3rd Engineering Foundation Conference on Advancing Food Technology with the Irradiation Process, Santa Barbara, Calif., 15 Nov. 1987
(Contract DE-AC03-83SF-11903)
(DE88-002702; CONF-8711103-1) Avail: NTIS HC A02/MF A01

A task group has been formed within the American Society for Testing and Materials (ASTM) specifically to develop standards for measuring radiation dose for food processing. The task group, which has 78 members, including 16 from Europe, consists of a broad cross section of food industry, government, regulatory, manufacturing, and university interests. The group is working on seven standards; three specifically for food irradiation applications, and four for using specific dosimeter types for all radiation applications, including food processing. Together, this set of standards will specify acceptable methods of accomplishing the required irradiation treatment of food and other products, and will

be available for adoption by regulatory agencies in food irradiation protocols. DOE

N88-17851# Messerschmitt-Boelkow-Blohm G.m.b.H., Hamburg (West Germany). Unternehmensgruppe Transport- und Verkehrsflugzeuge.
TRENDS IN THE DISTRIBUTION OF TASKS BETWEEN COMMERCIAL PILOTS AND FLIGHT CONTROL SYSTEMS [ZUR AUFGABENTEILUNG ZWISCHEN VERKEHRSPILOTEN UND FLUGFUEHRUNGSSYSTEMEN - TRENDS]
Hartwig Seeler *In its* Research and Development. Technical-Scientific Publications (1956-1987): Retrospective View and Prospects. Jubilee Edition on the Occasion of the 75th Anniversary of Dipl.-Engr. Dr.-Engr. E.H. Ludwig Boelkow 1987 p 203-208 In GERMAN (For primary document see N88-17819 10-31)
(MBB-UT-008/87) Copyright Avail: NTIS HC A14/MF A01

N88-18135# Joint Publications Research Service, Arlington, Va.
ANALYSIS OF WATER RECOVERED AFTER BEING USED FOR WASHING BY MEN AND WOMEN
A. A. Berlin and S. L. Chekanova *In its* JPRS Report: Science and Technology. USSR: Space Biology and Aerospace Medicine, v. 21, no. 5, Sep. - Oct. 1987 25 Feb. 1988 p 78-83 Transl. into ENGLISH from Kosmicheskaya Biologiya i Aviakosmicheskaya Meditsina (Moscow, USSR), v. 21, no. 5, Sep. - Oct. 1987 p 53-57 (For primary document see N88-18122 10-51)
Copyright Avail: NTIS HC A08/MF A01

55 SPACE BIOLOGY

Includes exobiology; planetary biology; and extraterrestrial life.

No abstracts in this category.

59 MATHEMATICAL AND COMPUTER SCIENCES (GENERAL)

No abstracts in this category.

60 COMPUTER OPERATIONS AND HARDWARE

Includes hardware for computer graphics, firmware, and data processing.

For components see *33 Electronics and Electrical Engineering.*

N88-18191# North Carolina Univ.,. Raleigh. Dept. of Electrical and Computer Engineering.
PROCEEDINGS OF THE WORKSHOP ON FUTURE DIRECTIONS IN COMPUTER ARCHITECTURE AND SOFTWARE
Dharmar P. Agrawal, ed. 30 Aug. 1986 421 p Workshop held in Charleston, S.C., 5-7 May 1986; sponsored by ARO, Research Triangle Park, N.C. Prepared for Battelle Columbus Labs., Ohio
(Contract DAAG29-81-D-0100)
(AD-A184949) Avail: NTIS HC A18/MF A01 CSCL 09B

Topics discussed include instruction set considerations, custom chips, memory hierarchy and parallel architecture, interconnection and reconfiguration strategies, granularity issues, mapping algorithms and task assignment, resuable and retargetable software, distributed operating systems, concurrency control, MIMO parallelism and support, distributed computing systems, architecture and software issues, logic and functional programming, VLSI and related issues, and applicative language and data flow techniques. For individual titles, see N88-18192 through N88-18258.

N88-18192# Carnegie-Mellon Univ., Pittsburgh, Pa. Dept. of Computer Science.
SOME FURTHER OBSERVATIONS ABOUT REDUCED INSTRUCTION SET COMPUTERS
E. Douglas Jensen *In* North Carolina Univ., Proceedings of the Workshop on Future Directions in Computer Architecture and Software 30 Aug. 1986 p 17-20 (For primary document see N88-18191 10-60)
Avail: NTIS HC A18/MF A01 CSCL 09B

One of the positive contributions of advocates of reduced instruction set computers (RISC) is renewed attention to the performance of the most frequently executed instructions; however, it is unjustified to conclude that only those instructions should be included. Instruction importance rather than frequency should determine what is optimized in the instruction set architecture. Instructions should be included as justified by cost-effectiveness tradeoffs to meet current system requirements, for example, performance, fault tolerance, and software compatibility. Other problems with RISC include dubious claims on design features that are not inherent to RISC but apply just as well to complex instruction set computers (CISC); and dependencies on semiconductor technology such that expensive GaAs-based systems would be necessary for efficient implementation. J.P.B.

N88-18193# Virginia Univ., Charlottesville. Dept. of Computer Science.
AN EMPIRICAL ANALYSIS OF THE LILITH INSTRUCTION SET
Robert P. Cook *In* North Carolina Univ., Proceedings of the Workshop on Future Directions in Computer Architecture and Software 30 Aug. 1986 p 21-28 Sponsored in part by Virginia Center for Innovative Technology, Navy, Burroughs Corp., and Modula Corp. (For primary document see N88-18191 10-60)
Avail: NTIS HC A18/MF A01 CSCL 09B

The Lilith computer was designed to support programming in Modula-2. A static analysis of the instructions used to implement all the system software on Lilith is described. The results are compared with a similar analysis performed on the Mesa instruction architecture which inspired Lilith. The Lilith, (MMP) Multiple Modula-2 processors project to extend Lilith for applications requiring large numbers of processors and a fast context switch time is also described, together with some of the experiments to be performed as part of the design effort. Author

N88-18194# Radio Corp. of America, Moorestown, N. J. Missile and Surface Radar Div.
HIGH-PERFORMANCE CPU IMPLEMENTATION OF THE NEBULA INSTRUCTION SET ARCHITECTURE
R. S. Cheng *In* North Carolina Univ., Proceedings of the Workshop on Future Directions in Computer Architecture and Software 30 Aug. 1986 p 29-36 (For primary document see N88-18191 10-60)
Avail: NTIS HC A18/MF A01 CSCL 09B

Nebula is an efficient 32-bit instruction set architecture (ISA) that directly supports Ada implementation. High system throughput, design flexibility, high testability and reliability, and compactness were the major design goals. The design was optimized based on an instruction mix. Extensive parallelism was introduced at all design levels. Redundant hardware and built-in test features support fault detection and isolation. A microprogrammable architecture was selected for high programmability. VLSI implementation minimizes the number of unique chip types and number of chips. The Nebula processor system and CPU architecture are described in detail. J.P.B.

N88-18195# Supercomputing Research Center, Lanham, Md.
THE ARITHMETIC CUBE AND ITS ASSOCIATED ALGORITHMS **c61**
Mary Jane Irwin and Robert Michael Owens (Pennsylvania State Univ., University Park.) *In* North Carolina Univ., Proceedings of the Workshop on Future Directions in Computer Architecture and Software 30 Aug. 1986 p 38-47 (For primary document see N88-18191 10-60)
(Contract DAAG29-83-K-0126)
Avail: NTIS HC A18/MF A01 CSCL 09B

The arithmetic cube can be programmed to solve linear transformations such as convolutions and discrete Fourier transforms (DFTs), has nearest neighbor interconnects, regular layout, simple control, and a limited number of interconnections. The cube contains an arithmetic processor, which is built out of adder and multiplier components, fed by memory. The primitive components are fine grain so that many can fit on a single chip. The architecture of the two primitive arithmetic components of the cube is discussed. An example of the use of the cube is given in a DFT problem. J.P.B.

N88-18196# Florida Univ., Gainesville. Dept. of Electrical Engineering.
THE DESIGN OF ULTRA HIGH-SPEED NUMERIC INTENSIVE SYSTEMS (HAVING FAULT TOLERANT AND LOAD BALANCING CAPABILITIES)
Fred J. Taylor *In* North Carolina Univ., Proceedings of the Workshop on Future Directions in Computer Architecture and Software 30 Aug. 1986 p 48-54 (For primary document see N88-18191 10-60)
Avail: NTIS HC A18/MF A01 CSCL 09B

Several milestones in the area of residue number system (RNS) are reported. These include: (1) extensions of the theory of the complex residue number system based on rings of Gaussian integers; (2) implementation of practical complex RNS units based on off-the-shelf hardware; and (3) study of discrete Fourier transforms (DFT) using recently developed RNS theory. Progress has also been made in the logarithmic number system (LNS). The results are being integrated into viable, highly parallel numeric intensive processor designs for defense applications. J.P.B.

N88-18197# BDM Corp., McLean, Va.
HARDWARE IMPLEMENTATION FOR SPECIAL FUNCTIONS. AN APPLICATION FOR COMBAT SIMULATION
John B. Gilmer, Jr. *In* North Carolina Univ., Proceedings of the Workshop on Future Directions in Computer Architecture and Software 30 Aug. 1986 p 55-60 (For primary document see N88-18191 10-60)
Avail: NTIS HC A18/MF A01 CSCL 09B

An approach to improving computer performance based on reducing key algorithms to hardware is outlined. This takes advantage of very fine grain parallelism which would otherwise require either complex control or unacceptable resource management overhead to handle. As computer-aided design and fabrication become more convenient and faster, such reduction to hardware should become as much a programming option as is current use of firmware. The effort outlined is to explore the means of doing this by reducing a well-defined algorithm to a hardware unit that can be plugged into the existing system used to execute the program. The algorithm chosen, hexagonal coordinate system addition, is an important calculation in the Corps Battle Analysis (CORBAN) simulation and similar software of importance to AirLand Battle Management. This algorithm's speedup of two orders of magnitude will allow speedup of the simulation limited only by the fact that its use comprises a fraction of simulation computation. Widespread use of this approach should result in significant speedup when applied to many component algorithms. Author

N88-18198# California Univ., Berkeley. Div. of Computer Science.
RESEARCH AND DEVELOPMENT TRENDS FOR MEMORY HIERARCHIES
Alan Jay Smith *In* North Carolina Univ., Proceedings of the Workshop on Future Directions in Computer Architecture and Software 30 Aug. 1986 p 62-71 Presented at the 18th Annual Hawaii Int. Conference on Systems Sciences, Honolulu, Jan. 1965 Sponsored in part by California State MICRO Program; IBM Corp.; Signetics Corp. (For primary document see N88-18191 10-60)
(Contract N00039-84-C-0089; Grant NSF DCR-82-02591)
Avail: NTIS HC A18/MF A01 CSCL 09B

Cache memory performance is often the limiting factor in computer CPU performance and cache memories also serve to cut the memory traffic in multiprocessor systems. Multiprocessor systems are also requiring advances in cache architecture with respect to cache consistency. Similarly, the study of the best means to share main memory is an important research topic. Disk cache is becoming important for performance in high end computer systems and is now widely available commercially; there are many related research problems. The development of mass storage, especially optical disk, will promote research in effective algorithms for file management and migration. Each component of the memory hierarchy is examined and two issues are addressed: (1) what are likely directions for development; and (2) what are the interesting research problems? Author

N88-18199# Army Stategic Defense Command, Huntsville, Ala.
SIGNAL AND DATA PROCESSING FOR IR SENSORS **c61**
D. E. Satterfield and R. C. Styles (Teledyne Brown Engineering, Huntsville, Ala.) *In* North Carolina Univ., Proceedings of the Workshop on Future Directions in Computer Architecture and Software 30 Aug. 1986 p 72-77 (For primary document see N88-18191 10-60)
Avail: NTIS HC A18/MF A01 CSCL 09B

An advanced long wave infrared (LWIR) signal and data processing testbed for studying and characterizing performance for various ballistic missile defense (BMD) missions has been developed. A full set of LWIR sensor signal and data processing algorithms has been developed for a probe-type sensor and many experimental results have been obtained. In addition, a complete complement of support software has been developed for this hardware-in-the-loop (HWIL) facility. Key technology issues for the Strategic Defense Initiative (SDI) are under consideration. Author

N88-18200# Bell Telephone Labs., Inc., Holmdel, N. J.
ON PARALLELISM IN SOFTWARE/HARDWARE DESIGN TOOLS **c61**
P. A. Subrahmanyam *In* North Carolina Univ., Proceedings of the Workshop on Future Directions in Computer Architecture and Software 30 Aug. 1986 p 78-84 (For primary document see N88-18191 10-60)
Avail: NTIS HC A18/MF A01 CSCL 09B

Opportunities for parallelism in some classes of computer-aided design tools are explored and a few insights are conveyed about exploiting the parallelism. More specifically, perspectives that bear on the design of hardware accelerators for some important classes of design tools are provided. Author

N88-18201# Bell Telephone Labs., Inc., Holmdel, N. J. Computer and Robotics Research Lab.
ROLE OF BROADCASTING IN MULTIPROCESSOR SYSTEMS **c62**
Binay Sugla and Sudhir Ahuja *In* North Carolina Univ., Proceedings of the Workshop on Future Directions in Computer Architecture and Software 30 Aug. 1986 p 86-89 (For primary document see N88-18191 10-60)
Avail: NTIS HC A18/MF A01 CSCL 09B

Broadcasting presents a powerful technique for parallel/distributed computing. Experiences with broadcasting in several multiprocessors built over the last few years are summarized. It has been found that broadcasting can play an important role not only in terms of improving algorithmic efficiency but also with respect to making the parallel programming environment more powerful. In order to substantiate this conclusion, the role of broadcasting in the design and implementation of parallel

algorithms (e.g., prefix computation) and in the implementation of the concurrent programming language Linda is presented. Author

N88-18202# Texas Instruments, Inc., Dallas.
IMAGE TEXTURE CLASSIFICATION WITH AN OPTICAL CROSSBAR INTERCONNECTED PROCESSOR **c62**
Alastair D. McAulay *In* North Carolina Univ., Proceedings of the Workshop on Future Directions in Computer Architecture and Software 30 Aug. 1986 p 90-97 (For primary document see N88-18191 10-60)
(Contract N00014-85-C-0755)
Avail: NTIS HC A18/MF A01 CSCL 09B

Efficient use of extensive parallelism with a wide range of algorithms is required to meet future computation demands. The problems are discussed of providing high performance, flexibility, extendability, reliability, and ease of programming. An optical crossbar interconnected processor is described, including the associated optics and programming methodology. The Levinson-Durbin algorithm for solving Toeplitz matrix equations is considered as an illustration of how 2-D autoregressive models could be computed for image texture classification. An executable flow graph is generated for the Levinson-Durbin algorithm with unrolled iterations. The flow graph is implemented on a simulator and the resulting activity chart shows a 100 percent efficiency once the pipeline is filled. The advantages and limitations of the proposed architecture are summarized. Author

N88-18203# University of Southwestern Louisiana, Lafayette. Center for Advanced Computer Studies.
MULTIPLE-BUS INTERCONNECTION FOR FUTURE MULTIPROCESSOR SYSTEMS
L. N. Bhuyan *In* North Carolina Univ., Proceedings of the Workshop on Future Directions in Computer Architecture and Software 30 Aug. 1986 p 98-101 (For primary document see N88-18191 10-60)
Avail: NTIS HC A18/MF A01 CSCL 09B

Much research has gone into the performance analysis of centralized tightly coupled multiple-bus interconnection networks (IN), assuming that a processor sends a request to any memory module with equal probability. Analysis has also been reported when a processor has a favorite memory. The bandwidth (BW) linearly increases with the increase in number of buses until it is saturated by the memory access conflicts. In centralized asynchronous tightly coupled operation, the processors send the memory request packets to the central controller. The central controller builds a queue for each memory and allocates buses to these memories in a cyclic fashion. The multiple bus offers a simple, flexible, fault-tolerant and easily expandable interconnection scheme. Author

N88-18204# Virginia Polytechnic Inst. and State Univ., Blacksburg. Dept. of Electrical Engineering.
AUTOMATICALLY RECONFIGURABLE COMPUTER ARCHITECTURE
F. Gail Gray *In* North Carolina Univ., Proceedings of the Workshop on Future Directions in Computer Architecture and Software 30 Aug. 1986 p 103-113 (For primary document see N88-18191 10-60)
(Grant DAAG29-82-F-0102)
Avail: NTIS HC A18/MF A01 CSCL 09B

A proposed automatically reconfigurable cellular architecture is described. The unique feature of this architecture is that the reconfiguration control is distributed within the system. There is no need for global broadcasting of switch settings. This reduces the interconnection complexity and the length of data paths. The system can reconfigure at the request of the applications software or in response to detected faults. This architecture supports fault tolerant applications since the reconfiguration can be self-triggered from within. The complete reconfiguration process can proceed without external interference. Author

N88-18205# Concordia Univ., Montreal (Quebec). Dept. of Computer Science.
IMPLEMENTATION OF A BUDDY FAILURE RECOVERY CONCEPT IN THE NOVAC SYSTEM **c61**
B. C. Desai *In* North Carolina Univ., Proceedings of the Workshop on Future Directions in Computer Architecture and Software 30 Aug. 1986 p 114-121 (For primary document see N88-18191 10-60)
Avail: NTIS HC A18/MF A01 CSCL 09B

The NOVAC project consists of a dynamically variable tree structured system for solving a class of combinatorial problems. The proposed multiprocessor structure consists of loosely coupled processors with no shared memory; each processor in the system can be a master or a slave or both. This system is to be built with off-the-shelf mini and microcomputers, and interconnected using an inexpensive asynchronous bus. The logical structure, consisting of a hierarchy of masters, each with a number of slaves, is natural for the set of problems which can be split up into a number of identical subproblems. The time required to solve such a problem could be, depending on its size and nature, hours, days, or weeks. The high costs involved in having an absolutely reliable system for such duration necessitated a recovery system using the buddy concept, in which the failure of one of the processors of a pair could be tolerated. The task assigned to the failed processor could be picked up from the last check point state stored in an online auxiliary storage device. Author

N88-18206*# Georgia Inst. of Tech., Atlanta. School of Information and Computer Science.
CLOUDS: A SUPPORT ARCHITECTURE FOR FAULT TOLERANT, DISTRIBUTED SYSTEMS
P. Dasgupta and R. J. LeBlanco, Jr. *In* North Carolina Univ., Proceedings of the Workshop on Future Directions in Computer Architecture and Software 30 Aug. 1986 p 122-129 (For primary document see N88-18191 10-60)
(Grants NAG1-430; NSF DCR-83-16590)
Avail: NTIS HC A18/MF A01 CSCL 09B

Clouds is a distributed operating system providing support for fault tolerance, location independence, reconfiguration, and transactions. The implementation paradigm uses objects and nested actions as building blocks. Subsystems and applications that can be supported by Clouds to further enhance the performance and utility of the system are also discussed. Author

N88-18207# Loral Instrumentation, San Diego, Calif.
A LARGE-GRAIN DATAFLOW ARCHITECTURE
Ian Kaplan *In* North Carolina Univ., Proceedings of the Workshop on Future Directions in Computer Architecture and Software 30 Aug. 1986 p 131-138 (For primary document see N88-18191 10-60)
Avail: NTIS HC A18/MF A01 CSCL 09B

The hardware and software of the Loral LDF 100 (trademark) dataflow parallel processor are described. This is a large-grain processor made from off-the-shelf hardware that can be programmed with off-the-shelf compilers, e.g., Fortran. The basic system consists of 11 processors; with expansion chassis, the number of processors can be increased up to 100. J.P.B.

N88-18208# Colorado State Univ., Fort Collins. Dept. of Computer Science.
SISAL: INITIAL MIMD PERFORMANCE RESULTS **c61**
R. R. Oldehoeft, D. C. Cann, and S. J. Allan *In* North Carolina Univ., Proceedings of the Workshop on Future Directions in Computer Architecture and Software 30 Aug. 1986 p 139-145 (For primary document see N88-18191 10-60)
Avail: NTIS HC A18/MF A01 CSCL 09B

SISAL (Streams and Iteration in a Single-Assignment Language) is a language for expressing algorithms to execute on highly concurrent computers. The compiler, run-time system, and performance are described. J.P.B.

N88-18209# Purdue Univ., West Lafayette, Ind. Dept. of Computer Sciences.
THE MAPPING OF PARALLEL ALGORITHMS TO RECONFIGURABLE PARALLEL ARCHITECTURES **c61**
Leah H. Jamieson, Howard Jay Siegel, Edward J. Delp, and Andrew Whinston *In* North Carolina Univ., Proceedings of the Workshop on Future Directions in Computer Architecture and Software 30 Aug. 1986 p 147-154 (For primary document see N88-18191 10-60)
(Contracts F30602-83-K-0119; N00014-85-C-2182; MDA904-85-5027; Grant F49620-86-K-0005)
Avail: NTIS HC A18/MF A01 CSCL 09B

Research on the mapping of algorithms to reconfigurable parallel architectures is presented. The thrust of the work is in identifying those characteristics of parallel algorithms which have the greatest effect on their execution, and in identifying a correspondence between those characteristics and the characteristics of parallel architectures. The context of this work is in the design of an Intelligent Operating System for the PASM reconfigurable multimicroprocessor system. The task of the Intelligent Operating System will be to direct the selection and scheduling of algorithms and the configuring of the architecture for the execution of an image understanding system. Author

N88-18210# Illinois Univ., Urbana. Dept. of Computer Science.
A DISTRIBUTED SYSTEM ARCHITECTURE BASED ON MACRO DATAFLOW MODEL **c62**
Jane W. S. Liu and Andrew Grimshaw *In* North Carolina Univ., Proceedings of the Workshop on Future Directions in Computer Architecture and Software 30 Aug. 1986 p 155-162 (For primary document see N88-18191 10-60)
(Grant NAG1-613)
Avail: NTIS HC A18/MF A01 CSCL 09B

A distributed system architecture based on the macro dataflow model of computation is proposed. This architecture appears to provide a framework within which high degrees of parallelism, fault tolerance, and availability can be achieved naturally in a distributed environment. An important problem to be solved concerns the provision of necessary underlying support to the resource management function. Naming, location, and selection of server modules to perform computation primitives invocated in programs, and the use of techniques such as atomic remote procedure calls and resilient procedures to ensure fault tolerance and improve availability are some of the issues. Author

N88-18211# Missouri Univ., Columbia. Dept. of Computer Sciences.
A COMPARATIVE STUDY OF HEURSTIC ALGORITHMS FOR TASK ASSIGNMENT IN DISTRIBUTED COMPUTING SYSTEMS **c62**
Kamal Efe *In* North Carolina Univ., Proceedings of the Workshop on Future Directions in Computer Architecture and Software 30 Aug. 1986 p 163-169 (For primary document see N88-18191 10-60)
Avail: NTIS HC A18/MF A01 CSCL 09B

There are many heuristic algorithms in the literature for task assignment in distributed computing systems. A common goal of all of these algorithms is to minimize the communication cost of an assignment. Each of the researchers who develop heuristic algorithms claim that their algorithms perform very well. The purpose of this paper is to compare the performance of four algorithms in the literature in terms of both accuracy and algorithmic efficiency. It is concluded that the trade-off between optimal but slow algorithms versus sub-optimal but efficient ones heavily favors the heuristic approach. A heuristic algorithm is derived to combine the most successful parts of the reviewed papers, and some remaining important problems are identified. Author

N88-18212# Stanford Univ., Calif. Dept. of Electrical Engineering.
WHY REUSABLE SOFTWARE ISN'T **c61**
William J. Tracz *In* North Carolina Univ., Proceedings of the Workshop on Future Directions in Computer Architecture and Software 30 Aug. 1986 p 171-177 Prepared in cooperation with IBM Federal Systems Div., Owego, N.Y. (For primary document see N88-18191 10-60)
Avail: NTIS HC A18/MF A01 CSCL 09B

The issue of why the paradigm of reusable software has not had the broad sweeping effects envisioned by some is examined. Difficulties in reusing software are discussed from the points of view of a programmer, software manager, computer scientist, and cognitive psychologist. Technical, organizational, political, and psychological bottlenecks are identified. Author

N88-18213# Illinois Univ., Urbana-Champaign. Dept. of Computer Science.
TOWARDS REUSABLE SOFTWARE DESIGNS AND IMPLEMENTATIONS **c61**
Ralph E. Johnson and Simon M. Kaplan *In* North Carolina Univ., Proceedings of the Workshop on Future Directions in Computer Architecture and Software 30 Aug. 1986 p 178-185 (For primary document see N88-18191 10-60)
Avail: NTIS HC A18/MF A01 CSCL 09B

One of the best ways to reduce the cost of producing software is to reuse old software instead of writing it anew. Although reusing small pieces of programs has long been practiced and software packages are also reused in their entirety, other products of the software design process, such as the general structure of a program or the design itself, are not formally reused. This paper discusses a new approach to the design and implementation of software systems. In this approach, a design is a formal mathematical object which can be instantiated as an object-oriented implementation. This allows reuse of both designs and implementations. Author

N88-18214# General Dynamics Corp., San Diego, Calif. Div. of General Dynamics Data Systems.
ARCHETYPING: A KNOWLEDGE-BASED REUSE PARADIGM **c61**
Stanley M. Przybyllnski *In* North Carolina Univ., Proceedings of the Workshop on Future Directions in Computer Architecture and Software 30 Aug. 1986 p 186-193 (For primary document see N88-18191 10-60)
Avail: NTIS HC A18/MF A01 CSCL 09B

DARTS, a proprietary software engineering environ ment, provides a unique answer to the software reuse question: archetyping, the use of embedded high-order language statements and an advanced macro-processing capability to automatically generate new versions of complex software systems. An overview of the technology of archetyping, including some examples of archetyped code, is provided, as well as a discussion of other knowledge-based applications of DARTS. Author

N88-18215# State Univ. of New York, Stony Brook. Dept. of Computer Science.
DISTRIBUTED CONTROL OF LARGE PARALLEL COMPUTERS **c62**
Larry D. Wittie *In* North Carolina Univ., Proceedings of the Workshop on Future Directions in Computer Architecture and Software 30 Aug. 1986 p 195-201 (For primary document see N88-18191 10-60)
Avail: NTIS HC A18/MF A01 CSCL 09B

The different operating systems of a number of types of parallel processors, including future massively parallel processors, are described. Tree-based distributed control algorithms are discussed, and a comparison is made between two failure recovery algorithms for trees. J.P.B.

N88-18216# Princeton Univ., N. J. Dept. of Computer Science.
THE DESIGN OF LOAD BALANCING STRATEGIES FOR DISTRIBUTED SYSTEMS **c62**
Rafael Alonso *In* North Carolina Univ., Proceedings of the Workshop on Future Directions in Computer Architecture and Software 30 Aug. 1986 p 202-207 (For primary document see N88-18191 10-60)
Avail: NTIS HC A18/MF A01 CSCL 09B

The problem of designing and selecting load balancing mechanisms for distributed systems based on local area networks is considered. The particular focus is on the type of information needed to make balancing decisions and on the desirable properties of the decision algorithms. An approach to this problem is described which consists of carrying out a series of experiments on a prototype load balancing implementation. Finally, insights derived from experimental results are presented. Author

N88-18217# Rice Univ., Houston, Tex. Dept. of Computer Science.
EXPERIMENTS WITH PARALLEL PROGRAM EXECUTION ON A NETWORK OF WORKSTATIONS **c62**
Willy Zwaenepoel *In* North Carolina Univ., Proceedings of the Workshop on Future Directions in Computer Architecture and Software 30 Aug. 1986 p 208-212 Sponsored in part by IBM Faculty Development Award (For primary document see N88-18191 10-60)
(Grant NSF DCR-85-11436)
Avail: NTIS HC A18/MF A01 CSCL 09B

The parallel execution of programs on a collection of workstations connected by a local area network is studied. Work has focused on developing a number of pilot applications, including a distributed Pascal compiler and a distributed make facility. These applications are intended as an experimental testbed for studying issues in problem partitioning, fault tolerance, machine allocation, and monitoring and debugging of distributed programs. Author

N88-18218# Microelectronics and Computer Technology Corp., Austin, Tex. Parallel Processing Program.
FUTURE DIRECTIONS IN COMPUTER ARCHITECTURE AND SOFTWARE: THE YEAR 2000
Stephen F. Lundstrom *In* North Carolina Univ., Proceedings of the Workshop on Future Directions in Computer Architecture and Software 30 Aug. 1986 p 214-218 (For primary document see N88-18191 10-60)
Avail: NTIS HC A18/MF A01 CSCL 09B

A computer technology forecast is presented based on extrapolating current trends and assessing the possibilities of several high-risk research topics. In the process, critical problem areas that require research and development emphasis are identified. Areas discussed include rapid turn-around design, flexible manufacturing, integrated vendors, and micro manufacturing. The impact of non-technical decisions such as the oil crisis, accounting and office management, and factory automation is also discussed. J.P.B.

N88-18219# Illinois Univ., Chicago. Dept. of Electrical Engineering and Computer Science.
DISTRIBUTED QUERY PROCESSING: PRESENT STATUS AND FUTURE DIRECTION **c62**
C. T. Yu and K. C. Guh *In* North Carolina Univ., Proceedings of the Workshop on Future Directions in Computer Architecture and Software 30 Aug. 1986 p 220-227 (For primary document see N88-18191 10-60)
Avail: NTIS HC A18/MF A01 CSCL 09B

The aim is to construct a powerful distributed query processing system, which is suitable for local area networks, long-haul networks and mixed networks where local area networks are interconnected by long distance lines. The system will be capable of processing logical queries (e.g., Prolog) as well as ordinary relational queries (e.g., Ingres types of queries), be able to learn to process queries more efficiently and be able to adapt to varying environments (e.g., partial system crash survivability). Author

N88-18220# Pennsylvania State Univ., University Park. Dept. of Electrical Engineering.
A PARADIGM FOR CONCURRENCY CONTROL PERFORMANCE EVALUATION **c62**
A. A. Helal, A. K. Elmogarmid, and A. R. Hurson *In* North Carolina Univ., Proceedings of the Workshop on Future Directions in Computer Architecture and Software 30 Aug. 1986 p 228-235 (For primary document see N88-18191 10-60)
Avail: NTIS HC A18/MF A01 CSCL 09B

Research in the area of concurrency control performance evaluation has been extensively addressed in the past few years. Unfortunately, conclusions arrived at by many researchers were inconsistent and at times contradictory. This inconsistency has arisen due to the different assumptions and performance models used. In order to eliminate this situation, a unified performance model is needed. A framework is proposed for concurrency control performance evaluation in single site data bases. Areas of performance studies are categorized, and a suggested performance model is specified. Author

N88-18221# Ohio State Univ., Columbus. Dept. of Computer and Information Science.
CONCURRENCY CONTROL AND RELIABILITY IN REPLICATED DATABASE SYSTEMS **c82**
Mukesh Singhal *In* North Carolina Univ., Proceedings of the Workshop on Future Directions in Computer Architecture and Software 30 Aug. 1986 p 236-243 (For primary document see N88-18191 10-60)
Avail: NTIS HC A18/MF A01 CSCL 05B

Distributed data base systems are of utmost importance to military exercises because such applications are inherently distributed and require severe performance constraints such as fast response time and continued operation in face of catastrophic failures. Several issues are examined in the design of high performance distributed database systems. In particular, the problem of concurrency control is discussed. This deals with controlling the concurrent access of a database by simultaneously running transactions so that the correctness of the data base is maintained, and with the problem of reliability which deals with the resiliency to different kinds of failures. The state of the art of these design issues is examined, and future directions for distributed data base systems are discussed. Author

N88-18222# Rensselaer Polytechnic Inst., Troy, N.Y. Dept. of Computer Science.
PREDICATE ANALYSIS FOR PARALLEL PROGRAM GENERATION **c62**
Boleslaw K. Szymanski *In* North Carolina Univ., Proceedings of the Workshop on Future Directions in Computer Architecture and Software 30 Aug. 1986 p 245-252 (For primary document see N88-18191 10-60)
Avail: NTIS HC A18/MF A01 CSCL 09B

New software development tools proposed for supercomputers are based on assertive programming, where a program is expressed as a set of assertions about its properties and not as a sequence of steps leading to the solution. Solving procedures are automatically generated from assertive description. Assertive programming for scientific parallel processing is supported by equational languages in which assertions are restricted to conditional equations. Such languages are naturally suited for mathematically oriented computations. Equational languages are also an effective tool for describing general computational tasks. Descriptions of many parallel algorithms are greatly simplified when written in that form. The MODEL equational language translator and its three cooperating components (compiler, configurator, and timer) are discussed. The focus is on the application of predicate analysis and automatic theorem proving in the area of arithmetic inequalities. Checking equational programs and optimization of generated parallel code are also discussed. Author

N88-18223# Martin Marietta Aerospace, Denver, Colo.
AN INVESTIGATION OF PARALLELISM IN RULE BASED SYSTEMS **c62**
Steven D. Raney and David A. Marshall *In* North Carolina Univ., Proceedings of the Workshop on Future Directions in Computer Architecture and Software 30 Aug. 1986 p 253-260 (For primary document see N88-18191 10-60)
Avail: NTIS HC A18/MF A01 CSCL 09B

For many applications, rule-based programming languages are too slow. The use of parallel architectures is being studied to

increase overall performance of a logic programming interpreter. Using a tightly-coupled multiprocessor, we have found that substantial performance increases can be obtained, and the parallelism inherent in logic programs can be easily exploited.
Author

N88-18224# Carnegie-Mellon Univ., Pittsburgh, Pa. Software Engineering Inst.
SOFTWARE SUPPORT FOR HETEROGENEOUS MACHINES **c61**
Mario R. Barbacci *In* North Carolina Univ., Proceedings of the Workshop on Future Directions in Computer Architecture and Software 30 Aug. 1986 p 261-268 (For primary document see N88-18191 10-60)
Avail: NTIS HC A18/MF A01 CSCL 09B

The objective was to investigate languages, methodologies, and tools for programming computer systems consisting of networks of heterogeneous processors. Typical users of these notations (and associated support software) will be the developers of real-time, computation-intensive applications such as those contemplated under the Strategic Computing Initiative. In particular, this research is being conducted in the context of the Autonomous Land Vehicle application, running on the Heterogeneous Machine being developed. Some background on the nature of the problem posed by these applications is provided, and opportunities presented by the emergence of heterogeneous machines and the goals of the project are discussed.
Author

N88-18225# North Carolina State Univ., Raleigh. Dept. of Electrical and Computer Engineering.
THE CASE FOR A SHARED ADDRESS SPACE **c62**
Edward F. Gehringer *In* North Carolina Univ., Proceedings of the Workshop on Future Directions in Computer Architecture and Software 30 Aug. 1986 p 270-272 (For primary document see N88-18191 10-60)
(Contract MDA904-86-14-0003)
Avail: NTIS HC A18/MF A01 CSCL 09B

Multiprocessor systems that allow processors to access individual words in each others' local memories can efficiently execute a large class of parallel algorithms. Global search, interprocess synchronization, and some forms of transaction processing execute several times more efficiently in a shared address-space environment than in a system that provides only message passing. Though provided by relatively few multiprocessors, shared address spaces can be implemented quite easily on systems that provide separate communication and application processors at each node.
Author

N88-18226# Michigan Univ., Ann Arbor. Dept. of Electrical Engineering and Computer Science.
THE NEXT GENERATION OF HYPERCUBE COMPUTERS
Trevor Mudge *In* North Carolina Univ., Proceedings of the Workshop on Future Directions in Computer Architecture and Software 30 Aug. 1986 p 273-275 (For primary document see N88-18191 10-60)
(Grant DAAG29-84-K-0070)
Avail: NTIS HC A18/MF A01 CSCL 09B

Massively parallel computers based on hypercube architectures offer an alternative to traditional supercomputers at much less cost. The attractiveness of the hypercube over other geometries can be attributed to the slow growth in worst-case internode distance with N, the slow growth in the number of connections to adjacent nodes with N, the recursive structure of the hypercube, the similarity of nodes, and the ease with thich trees and meshes of all dimensions can be embedded. Expected developments for the near future are summarized. The point is made that software is the major obstacle to the widespread use of hypercube machines.
Author

N88-18227# Rensselaer Polytechnic Inst., Troy, N.Y. Dept. of Computer Science and Center for Integrated Electronics.
A PARALLEL COMPUTER BASED ON CUBE CONNECTED CYCLES **c62**
M. J. Chung, E. J. Toy, and A. A. Lobo *In* North Carolina Univ., Proceedings of the Workshop on Future Directions in Computer Architecture and Software 30 Aug. 1986 p 276-278 (For primary document see N88-18191 10-60)
Avail: NTIS HC A18/MF A01 CSCL 09B

A parallel programming environment for SIMD computers is proposed, based on the specification of an arbitrary or logical network of processors. The underlying network should be a general-purpose SIMD computer of 512 processing elements (PE) capable of operations on problem sizes up to 32,768 data points. The processors are connected with the Cube Connected Cycles (CCC) network. The salient features of the CCC network are: (1) interprocessor connections are strictly limited to three; (2) highly regular network control; (3) identical PEs; (4) a high degree of pipelining can be achieved; and (5) efficient emulation of other networks. The computer is intended for general-purpose, scientific calculations and it is estimated that the computing power falls within the range of 500 to 1000 MIPs.
Author

N88-18228# North Carolina State Univ., Raleigh. Dept. of Electrical and Computer Engineering.
AN ANLYSIS OF THE RELIABILITY OF TREE-STRUCTURED INTERCONNECTION NETWORKS **c62**
Ravi Mehrotra and Edward F. Gehringer *In* North Carolina Univ., Proceedings of the Workshop on Future Directions in Computer Architecture and Software 30 Aug. 1986 p 279-283 (For primary document see N88-18191 10-60)
Avail: NTIS HC A18/MF A01 CSCL 09B

A mathematical model of reliability for tree-structured networks of processors is presented. It is assumed that processing elements have an equal probability of failure, and that interconnection links also have a fixed failure probability. From these two probabilities and the number of nodes in the network, a general formula is derived for the average number of nodes remaining connected. It is shown that if an operational tree of a certain size is desired, it is usually more efficacious to improve the reliability of individual processing elements and links than to add more nodes to the network. Indeed, to take best advantage of a large network, the reliability of the individual links must be higher than in smaller networks. The reliability of a randomly structured network is then compared with that of an n-ary tree network. The n-ary tree is shown to be significantly more reliable than the average tree.
Author

N88-18229# Clemson Univ., S.C. Dept. of Computer Science.
PERFORMANCE EVALUATION OF A LOOP INTERCONNECTION STRUCTURE **c62**
Edward W. Page *In* North Carolina Univ., Proceedings of the Workshop on Future Directions in Computer Architecture and Software 30 Aug. 1986 p 284-286 (For primary document see N88-18191 10-60)
Avail: NTIS HC A18/MF A01 CSCL 09B

The results of a simulation study of the potential performance of loop-connected multiprocessor systems are reported. Results show that, with a judicious choice in binding of processes to processors, the performance of the loop-connected system can grow almost linearly without bound. However, a poor choice in the assignment of processes to processors in a loop-connected system can result in performance that is even worse than the bus in saturation. The study indicates that the loop is most attractive in applications in which traffic patterns are known and can be synchronized.
Author

N88-18230# Michigan Univ., Ann Arbor. Dept. of Electrical Engineering and Computer Science.
ON THE NUMBER OF TASK ASSIGNMENTS IN DISTRIBUTED COMPUTING SYSTEMS **c62**
Kang G. Shin *In* North Carolina Univ., Proceedings of the Workshop on Future Directions in Computer Architecture and Software 30 Aug. 1986 p 287-288 (For primary document see N88-18191 10-60)
(Contract N00014-85-K-0122)
Avail: NTIS HC A18/MF A01 CSCL 09B

This work is concerned with the determintation of the number of acceptable task assignments rather than the task assignments themselves. The bounds of this number are derived when the task and processor graphs are arbitrary, and then a recursive formula for the number is provided when the task graph is restricted to a tree. A non-recursive closed form of the number can be derived for special cases, which is of importance for applications such as hypercube multiprocessors. The knowledge of the number of task assignments is applied to: (1) the problem of determining the inter-processor communication link which is of the utmost importance to the system admissibility of incoming tasks; and (2) the state-space search of the task assignment problem where the search is guided toward an ampler state-space without computing the associated heuristic function for every possible case. J.P.B.

N88-18231# Michigan State Univ., East Lansing. Dept. of Computer Science.
REUSE: A RELIABLE UNIFIED SERVICE ENVIRONMENT FOR DISTRIBUTED SYSTEMS **c62**
Lionel M. Ni and Thomas B. Gendreau *In* North Carolina Univ., Proceedings of the Workshop on Future Directions in Computer Architecture and Software 30 Aug. 1986 p 290-292 (For primary document see N88-18191 10-60)
Avail: NTIS HC A18/MF A01 CSCL 09B

Distributed control algorithms that provide a reliable unified service environment (REUSE) are being investigated. A client/server group model is used in which clients request a well-known service to be performed; it is then performed by a particular server process. Considerations of reliable interprocess communication, distributed algorithm development, and reliable server groups are discussed. J.P.B.

N88-18232# Monash Univ., Clayton (Australia).
ASPECTS OF A MULTIPROCESSOR ARCHITECTURE **c62**
R. Pose, M. S. Anderson, and C. S. Wallace *In* North Carolina Univ., Proceedings of the Workshop on Future Directions in Computer Architecture and Software 30 Aug. 1986 p 293-295 (For primary document see N88-18191 10-60)
Avail: NTIS HC A18/MF A01 CSCL 09B

The potential of tightly coupled multiprocessors to provide general-purpose computing services in an economical and readily expanded fashion is investigated. The system is viewed as a pool of processors each able to access any of a pool of memory units. To allow arbitrary cooperation among processes and indefinite expansion of the system, a uniform, very large virtual memory is defined. A capability system provides security via a look-up prior to the use of any data set or process; capabilities are held in a window table to avoid repeated rechecking for re-used processes. Each multiprocessor has its own intermediate address space, onto which is mapped every object of current interest to the processor. The vertical memory allows sharing of data objects among many processes. As with most multiprocessors, cache is used to permit each processing unit access to every memory module without tying up the bus. Disk storage for objects is provided via disk controllers which access memory modules in the same way as processing units. A prototype has been in operation since January 1986. J.P.B.

N88-18233# Florida Univ., Gainesville. Coll. of Engineering.
DIRECTIONS IN COMPUTER GRAPHICS ARCHITECTURE
John Staudhammer *In* North Carolina Univ., Proceedings of the Workshop on Future Directions in Computer Architecture and Software 30 Aug. 1986 p 296-298 (For primary document see N88-18191 10-60)
Avail: NTIS HC A18/MF A01 CSCL 09B

Taking advantage of the image characteristics typical in three-dimensional computer-aided design, one can build inexpensive coding and decoding machines which will reduce the amount of data required for the description of acceptable images. Data compaction schemes now being addressed by special display chips handle specific image generatin problems and are candidates for very large scale integration (VLSI). The computations required for detailed image presentation seem to mandate supercomputer use, which implies that algorithms need to be devised which are more suitable for vector machines. Progress is partially embodied in a variety of commercial developments such as the emergence of graphics controllers directed towards video RAMs. Significant developments will occur in the areas where it is recognized that the most beautiful image is not necessarily the most useful (e.g., moving image sequences). J.P.B.

N88-18234# Bradley Univ., Peoria, Ill. Dept. of Computer Science.
DEVELOPING A STANDARD TAXONOMY OR SOFTWARE ENGINEERING STANDARDS **c61**
John Fendrich *In* North Carolina Univ., Proceedings of the Workshop on Future Directions in Computer Architecture and Software 30 Aug. 1986 p 299-300 (For primary document see N88-18191 10-60)
Avail: NTIS HC A18/MF A01 CSCL 09B

The work of the P1002 project of the Institute of Electrical and Electronics Engineers (IEEE) Subcommittee on Software Engineering Standards produced a draft standard taxonomy for classifying already existing standards and potential standards. The taxonomy consists of: (1) a partition of standards organized by type of standard (profession, product, and process); (2) a partition of software engineering organized by function and life cycle; and (3) a framework which relates to the two partitions to achieve, in matrix form, a partition of software engineering standards. J.P.B.

N88-18235# Clemson Univ., S.C. Dept. of Computer Science.
SAGE: THE CLEMSON UNIVERSITY SYSTOLIC ARRAY GENERATING ENGINE
Roy P. Pargas and Keith R. Allen *In* North Carolina Univ., Proceedings of the Workshop on Future Directions in Computer Architecture and Software 30 Aug. 1986 p 301-303 (For primary document see N88-18191 10-60)
Avail: NTIS HC A18/MF A01 CSCL 09B

The Systolic Array Generating Engine (SAGE) allows a user to key in a nested loop algorithm in a high-level language and, for certain types of algorithms, such as convolution, matrix-vector multiplication, matrix-matrix multiplication, polynomial evaluation, and linear recurrences, automatically generates systolic array solutions. Possible directions in the automatic generation of systolic arrays are discussed. Author

N88-18236# Old Dominion Univ., Norfolk, Va. Dept. of Electrical Engineering.
STRATEGIES FOR CONCURRENT PROCESSING OF COMPLEX ALGORITHMS **c61**
John W. Stoughton and Roland R. Mielke *In* North Carolina Univ., Proceedings of the Workshop on Future Directions in Computer Architecture and Software 30 Aug. 1986 p 304-306 (For primary document see N88-18191 10-60)
Avail: NTIS HC A18/MF A01 CSCL 09B

A modeling strategy is proposed which addresses the data flow consistency between algorithm and architecture in a concurrent processing environment. Algorithms of interest are decomposed into primitive tasks which are considered to be computationally intensive. This model is based upon a Petri net description of the data management for each node of the data flow graph. The node Petri net model is actually represented by a marked graph (NMG). Subsequent interconnection of these NMGs corresponding to the algorithm data flow graph leads to the computation marked graph (CMG) of the algorithm. Thus the NMG is a primitive subgraph of the CMG. Two important features of the model are that data flow is preserved and control flow is identified and managed with separate tokens. Further, the model leads to simple rules as the basis of design of data driven architecture. It is assumed that the architecture is static in that only one processor can instantiate one node at a time. Of theoretical interest is that the model will promote better understanding of how to decompose algorithms to maximize processing concurrency. Such issues as throughput, initialization, and deadlock can be interpreted in a graph context. Author

N88-18237# Ecole Normale Superieure, Saint Cloud (France).
PORTABLE (AND DISPOSABLE) INTERPRETERS c61
Francois-Xavier Testard-Vaillant *In* North Carolina Univ., Proceedings of the Workshop on Future Directions in Computer Architecture and Software 30 Aug. 1986 p 307-314 Prepared in cooperation with Laboratoire d'Informatique Theorique et Programmation, Paris (France) (For primary document see N88-18191 10-60)
Avail: NTIS HC A18/MF A01 CSCL 09B

A methodology is proposed for quick, clean interpreter implementation in high level languages. It is based upon a formal and operational description of stack manipulations using the mechanism of exceptions. This formalism provides a powerful tool to write or extend an interpreter from its meta-circular definition, e.g., Lisp or Prolog. Author

N88-18238# South Carolina Univ., Columbia. Dept. of Electrical and Computer Engineering.
A RULE-BASED LISP DIALECT TRANSLATOR USING PARAMODULATION c61
Michael Dowell and Yoshiyasu Takefuji *In* North Carolina Univ., Proceedings of the Workshop on Future Directions in Computer Architecture and Software 30 Aug. 1986 p 316-318 (For primary document see N88-18191 10-60)
Avail: NTIS HC A18/MF A01 CSCL 09B

A rule-based Lisp dialect translator (LDT) is presented. The advantage of using a rule-based system is to allow the user to supply his own rules for translation and thus the translator can be considered a general purpose dialect converter. The translation being used for development is Franz to Common Lisp. Author

N88-18239# Bolt, Beranek, and Newman, Inc., Cambridge, Mass.
SEMI-APPLICATIVE PROGRAMMING c61
N. S. Sridharan *In* North Carolina Univ., Proceedings of the Workshop on Future Directions in Computer Architecture and Software 30 Aug. 1986 p 319-322 (For primary document see N88-18191 10-60)
(Contract N00014-85-C-0079)
Avail: NTIS HC A18/MF A01 CSCL 09B

Results of a study on parsing algorithms for context-free grammars were presented in the full-length version of this paper. The starting point is the specification of a recognizer for context-free grammars in Chomsky Normal Form (CNF). A variety of different purely applicative parallel recognition algorithms are derived by transformations. Program annotations are introduced and semi-applicative algorithms are displayed. In one algorithm, it is shown how adaptive scheduling can control the behavior exhibited by the algorithm. The use of transformations, annotations, and scheduling as means of controlling program behavior is recommended. Author

N88-18240# Temple Univ., Philadelphia, Pa.
EXPERIMENTING WITH PARALLEL PROGRAMING IN LOGIC c61
Abraham Wakeman *In* North Carolina Univ., Proceedings of the Workshop on Future Directions in Computer Architecture and Software 30 Aug. 1986 p 323-325 (For primary document see N88-18191 10-60)
Avail: NTIS HC A18/MF A01 CSCL 09B

An extension is presented to the logic programming language Prolog, SISPRO (Super 'is' Prolog). This extension is on a very small scale but is typical of other efforts in this area to extend the capability of purely logic programs to handle also functional constructs. The particular extension discussed is realized by the introduction of a rewrite rule permitting the specification of functional terms to reside side by side with logical terms. A new local variable assignment operator is also introduced to take the place of the conventional 'is' operator. The implementation of SISPRO was achieved by the creation of a small interpreter written in regular Prolog. This is but a small example of the use of Prolog as a language for the creation of runnable specification for software. Author

N88-18241# Texas Univ., Austin. Dept. of Computer Science.
PARALLEL ARCHITECTURES FOR LOGIC PROGRAMMING c62
Vipin Kumer and Yow-Jian Lin *In* North Carolina Univ., Proceedings of the Workshop on Future Directions in Computer Architecture and Software 30 Aug. 1986 p 326-327 (For primary document see N88-18191 10-60)
(Grant DAAG29-84-K-0060)
Avail: NTIS HC A18/MF A01 CSCL 09B

Parallel logic programming architectures for Artificial Intelligence (AI) applications are investigated. Logic programming provides a convient paradigm for expressing parallelism because it allows the separation of logic and control in an algorithm. Potential parallelism in a logic program can be extremely large. Various ways are investigated of using parallelism in logic programs and architectures for implementing them. A parallel execution model for logic programming was developed. The model is process based and uncovers both AND and OR parallelisms, which makes it particularly suited for AI applications. A strategy was developed which controls the exploitation of AND parallelism with the help of domain specific information provided by the programmer, and has minimal run time overhead. Author

N88-18242# Worcester Polytechnic Inst., Mass. Dept. of Electrical Engineering.
REAL TIME ARTIFICIAL INTELLIGENCE ARCHITECTURE c63
Peter E. Green, Ronald J. Juels, and William R. Michalson (Raytheon Co., Sudbury, Mass.) *In* North Carolina Univ., Proceedings of the Workshop on Future Directions in Computer Architecture and Software 30 Aug. 1986 p 328-330 (For primary document see N88-18191 10-60)
Avail: NTIS HC A18/MF A01 CSCL 09B

This research is part of an overall research project into real time intelligent systems. The goal is to learn how to build the next generation of systems which have extensive embedded decision making capability. The trend is to embed ever increasing amounts of computational power into systems and to transfer responsibility for decision making from the human operator to the computers embedded within the system. The goal is to be able to build highly complex systems that are reliable and fault tolerant and yet can be operated by people who do not need a detailed knowledge of how the system works. Specifically, the research is concerned with the development of hardware and software structures for real time resource limited decision making by computer. Also investigated is an architecture for an Activation Cell Processor (ACP) which uses specialized VLSI chips in conjunction with standard VLSI processor components to provide an efficient environment for supporting the activation framework. Author

N88-18243# Advanced Decision Systems, Mountain View, Calif.
A STRATEGY FOR FAILURE PREDICTION
Dorothy M. Andrews *In* North Carolina Univ., Proceedings of the Workshop on Future Directions in Computer Architecture and Software 30 Aug. 1986 p 332-333 Prepared in cooperation with Stanford Univ., Calif. (For primary document see N88-18191 10-60)
(Contract DAAG29-82-K-105)
Avail: NTIS HC A18/MF A01 CSCL 09B

The main objective of a failure prediction system is to prevent catastrophic failures; however, a secondary objective is to provide early (and automated) diagnosis of possible component failure. Early diagnosis of potential problems allows recovery procedures to be initiated sooner and thereby improve the possibility of preventing failures. The sooner reconfiguration is enabled for systems having distributed architectures, the less chance there is that data corruption and other related distributed system problems will occur. The failure prediction strategy proposed is based on actual error statistics (and probabilities) and could be implemented using artificial intelligence technologies. A particularly useful feature would be to build an adaptive or learning algorithm into the implementation of a failure prediction strategy in order to improve

diagnostic capabilities. If this were done, then changes in architectures of the host computer would not require a completely new implementation of a failure prediction strategy. Author

N88-18244# North Carolina State Univ., Raleigh. Dept. of Computer Science.
PROGRAMMING LANGUAGE TRANSLATION FOR MULTICOMPUTERS c61
Jon Mauney *In* North Carolina Univ., Proceedings of the Workshop on Future Directions in Computer Architecture and Software 30 Aug. 1986 p 334-335 (For primary document see N88-18191 10-60)
Avail: NTIS HC A18/MF A01 CSCL 09B

Programming is a major challenge in effective use of parallel systems. The problem for language and compiler researchers in the future is to provide languages convenient to programming and compilers to translate them to efficient parallel code. The problem of compiling for parallel target machines can be divided into two phases: parallelism detection and parallelism exploitation. Detection is the process of discovering which activities may be performed in parallel; exploitation is the process of determining which activities will in fact be performed in parallel on the limited resources of the machine. Parallel detection can be performed without regard to the characteristics of the target machine; parallelism exploitation is dependent on the machine, but is independent of the language in which the program was written. Just as traditional optimization techniques for sequential machines are divided into machine independent and machine dependent parts, so should optimizations for parallel machines be divided into machine independent parallelism detection and machine dependent parallelism exploitation. Author

N88-18245# Illinois Univ., Urbana-Champaign. Dept. of Computer Science.
RESILIENT PROCEDURES: A STRUCTURED REPLICATION APPROACH c61
Kwei-Jay Lin and Mark E. Wittle *In* North Carolina Univ., Proceedings of the Workshop on Future Directions in Computer Architecture and Software 30 Aug. 1986 p 336-338 Sponsored in part by Illinois Univ., Urbana (For primary document see N88-18191 10-60)
Avail: NTIS HC A18/MF A01 CSCL 09B

A new system construct, Resilient Procedures (RP), which has the desirable properties of fault tolerance and availability is presented. The atomicity and heterogeneous issues that can occur when replicating a procedure is discussed. It is further showed that the structure can be used for many applications in distributed and parallel computations. By allowing the used to specify the degree of replication, the diversity of replications (e.g., heterogeneous sites, software versions, etc.), and the method of coordination, the RP construct provides the user a friendly and powerful programming environment. Author

N88-18246# Case Western Reserve Univ., Cleveland, Ohio. Center for Automation and Intelligence Systems.
PARALLELISM AT THE MICROLEVEL: COOPERATIVE MICROCONTROLLERS WITH REAL TIME CONSIDERATIONS
Christos A. Papachristou *In* North Carolina Univ., Proceedings of the Workshop on Future Directions in Computer Architecture and Software 30 Aug. 1986 p 340-342 (For primary document see N88-18191 10-60)
Avail: NTIS HC A18/MF A01 CSCL 09B

An approach is proposed to low level parallel processing. Parallelism at the microlevel refers to a multiprocessing environment controlled by cooperative microengines executing concurrent microcode. This environment provides the capability for parallel implementation of functions via concurrent microprogramming. This would essentially constitute parallel firmware migration. The reasons for parallel migration are quite similar to the ones of function migration in uniprocessing structures; namely, substantial gains in speed, reliability and stability. Moreover, due to faster time response, microlevel parallelism would be better equiped to handle real time applications, e.g., multisensor functioning of a complex automation systems. The essential ideas of a new technique for function migration in a uniprocessor controlled environment are presented. Then, the structure is described of a cooperative microcontrol system together with extended sequencing protocols to support concurrency at the microlevel. Author

N88-18247# Rensselaer Polytechnic Inst., Troy, N.Y. Center for Integrated Electronics.
WAFER SCALE IMPLEMENTATION OF A GaAs SYSTOLIC SIGNAL PROCESSOR CELL c61
H. Merchant, H. Greub, R. Schreiber, B. Donlan, and J. F. McDonald *In* North Carolina Univ., Proceedings of the Workshop on Future Directions in Computer Architecture and Software 30 Aug. 1986 p 343-345 (For primary document see N88-18191 10-60)
Avail: NTIS HC A18/MF A01 CSCL 09B

Some preliminary results obtained by the authors while attempting to design a systolic signal processing element to be implemented using the Textronix-TRIQUINT GaAs E/D MESFET Foundry are described. Wafer integration of many small GaAs E/D MESFET cells offers an attractive alternative to VLSI when the yield is low for the latter. Author

N88-18248# Auburn Univ., Ala. Dept. of Computer Science and Engineering.
DESIGN FOR A TPL COMPLIER SYSTEM: A SYSTEM FOR RETARGETING HIGH LEVEL LANGUAGE PROGRAMS
S. Leong, O. Jiang, S. Jodis, and P. A. D. deMaine *In* North Carolina Univ., Proceedings of the Workshop on Future Directions in Computer Architecture and Software 30 Aug. 1986 p 346-348 (For primary document see N88-18191 10-60)
Avail: NTIS HC A18/MF A01 CSCL 09B

A key problem is the retargeting of software coded in high level languages so that they will efficiently execute in new computer environments that may have totally different computer architectures and/or supporting software. A standard high level language like Ada that is fully transportable cannot, by itself, solve the fundamental problem of transporting existing programs to new environments. Mimicking, either by hardware or software, the source environment is not a viable solution because such methods must be separately implemented for every different object environment and they do not fully exploit the characteristics of the new environments. In the Transportable Programming Language (TPL) method the essential concept is a retargetable bifunctional compiler, called the HLL-TPL compiler, that uses a hypothetical language, called the Hypothetical Parent High Level Language (HPHLL), as the transporting or retargeting vehicle. The HLL-TPL Compiler, which can be retargeted for any environment, converts the local dialet to the HPHLL and visa-versa. That means the TPL System, which consists of the HLL-TPL Compiler and its supporting software, can be transported or retargeted by itself. Author

N88-18249# Southern Methodist Univ., Dallas, Tex.
A VLSI IMPLEMENTABLE BLOCK ORIENTED DATA DRIVEN MULTIPROCESSOR
B. Shirazi and A. R. Hurson (Pennsylvania State Univ., University Park.) *In* North Carolina Univ., Proceedings of the Workshop on Future Directions in Computer Architecture and Software 30 Aug. 1986 p 349-352 (For primary document see N88-18191 10-60)
Avail: NTIS HC A18/MF A01 CSCL 09B

The traditional parallel processing approaches to closing the computational gap have consistently failed since parallelism has been forced through the extensions of the sequential von Neumann model rather than using an inherently parallel model. The data driven model allows a high degree of parallelism and asynchrony among its basic operators and thus, it has been considered a promising alternate to the von Neumann based architecture. This paper first discusses the trend in the design of the data driven machines through a classification of these systems. It then addresses the design of a processing module capable of executing

a program block in data driven fashion. These processing modules are used as the building blocks for the construction of a block driven multiprocessor. The organization of this system matches the semantics of the block and data driven models by allowing efficient and faster intra block as opposed to the longer interblock communications. In addition to the basic design the VLSI complexity of the system is addressed by estimating the geometry area of the basic elements and the timimg delay of the operation based on the current technology. Author

N88-18250# Ottawa Univ. (Ontario). Dept. of Computer Science.
ON SYSTOLIC ARCHITECTURES FOR INTERPOLATION AND INTEGRATION
S. I. Omar and G. H. Masapati *In* North Carolina Univ., Proceedings of the Workshop on Future Directions in Computer Architecture and Software 30 Aug. 1986 p 353-356 (For primary document see N88-18191 10-60)
Avail: NTIS HC A18/MF A01 CSCL 09B

Recent advances in custom VLSI chip fabrication technology have made it economically feasible to implement parts of a system in hardware. A number of issues have to be addressed if this approach is used. One of them is the systematic derivation of a processing architecture from specification of subsystem. This issue is addressed. The basic approach used is the Transformational or Mapping approach. This version of the approach differs from others in several respects. After producing an Algorithm model from Recurrence Relations a Processing System Model is derived algorithmically. Interpolation and Integration have been used as examples. Author

N88-18251# Indiana Univ., Bloomington. Dept. of Computer Science.
AN APPLICATIVE PROGRAMMER'S APPROACH TO MATRIX ALGEBRA, LESSONS FOR HARDWARE AND SOFTWARE **c61**
David S. Wise *In* North Carolina Univ., Proceedings of the Workshop on Future Directions in Computer Architecture and Software 30 Aug. 1986 p 357-359 (For primary document see N88-18191 10-60)
(Grant NSF DCR-84-05241)
Avail: NTIS HC A18/MF A01 CSCL 09B

It has been ten years since the data pull nature of the lazy applicative programming was proposed as a solution to the process fragmentation problem of parallel processing. There has since been considerable hardware development, both pipelined/vector machines and, more recently, cube- and switch-connected engines composed of tens and hundreds of processors. The style of programming for the former machines has not improved, and there are no suitable languages for taking appropriate advantage of the latter. At the same time, the early development of machines derived from applicative languages has proceeded from combinator-based hardware to more elaborate multiprocessor architectures. Algorithms are proposed which are derived using applicative programmimg, suitable for multiprocessors switch-connected to a banked (self-managing) heap memory. Although shared-memory access to M locations requires time at least logarithmic in M, we are accustomed to constant-time access (for small M- or cache), which is finally disappearing in tree- and switch-connected multiprocessor proposals. Moreover, there are several solutions, some in hardware, for distributing management of a shared heap. Author

N88-18252# Utah Univ., Salt Lake City. Dept. of Computer Science.
IMPLEMENTING LOGICAL VARIABLES ON A GRAPH REDUCTION ARCHITECTURE **c61**
Gary Linstrom *In* North Carolina Univ., Proceedings of the Workshop on Future Directions in Computer Architecture and Software 30 Aug. 1986 p 361-363 Sponsored in part by Shared Univ. Research Grant from IBM Corp. (For primary document see N88-18191 10-60)
(Grant NSF DCR-85-06000)
Avail: NTIS HC A18/MF A01 CSCL 09B

Logical variables offer a semantic meeting ground between functional and logic programming languages. From the perspective of functional programming, logical variables present a radically different basis for information flow. In particular, logical variables are not directly bound by uniquely determined expressions, in contrast to the customary dataflow orientation of functional languages; rather, they denote values determined by the interaction of successively applied constraints. In a functional programming language with logical variables, this difference can permit novel effects otherwise difficult to obtain, i.e., an action or a distance effect, whereby certain kinds of side-effects can be achieved within an applicative setting (the Prolog difference list trick for constant time list concatenation is a familiar example); a stronger object orientation, under which logical variables play the role of mutable shared entities; and the use of this object orientation as a basis for isotropic process communication and synchronization, as in Concurrent Prolog. Graph reduction offers many advantages as a strategy for executing applicative programs. These include: very flexible patterns of concurrency and load distribution on parallel architectures; clean support for infinite and cyclic data structures through demand evaluation; good program and data locality effects; the support of recursion and iteration without the need for explicit token objects or color tags and associative memories for their assembly into firing sets; and the ability to incorporate a form of data-drive as a submode. Author

N88-18253# Washington State Univ., Pullman. Dept. of Electrical and Computer Engineering.
MULTI-PROCESSOR REDUCTION MACHINES **c62**
J. L. Meador and M. L. Manwaring *In* North Carolina Univ., Proceedings of the Workshop on Future Directions in Computer Architecture and Software 30 Aug. 1986 p 364-366 (For primary document see N88-18191 10-60)
Avail: NTIS HC A18/MF A01 CSCL 09B

For future symbolic multi-processing, networks of several hundred processors are anticipated, each consisting of 10 K to 20 K devices. At 1984 commercial densities this equates to 4 to 8 devices per chip. According to anticipated 1988 densities, this can be expected to increase to as many as 128 per chip. The time is quickly approaching when the technology will support large scale symbolic parallelism, but only if ways can be found to efficiently implement it. To help achieve this goal, there is a need to investigate moderately sized, computationally versatile processors designed for efficient inter-processor communication within a multi-processor organization. Author

N88-18254# Massachusetts Inst. of Tech., Cambridge. Dept. of EECS.
MASSIVE FINE-GRAIN PARALLELISM IN ARRAY COMPUTATION: A DATA FLOW SOLUTION **c62**
Guang R. Gao *In* North Carolina Univ., Proceedings of the Workshop on Future Directions in Computer Architecture and Software 30 Aug. 1986 p 367-369 (For primary document see N88-18191 10-60)
Avail: NTIS HC A18/MF A01 CSCL 09B

It is argued that massive parallelism in vector computation can be exploited effectively utilizing data flow principles in future generation computers. The key is to organize the data flow machine program graph such that array operations can be fully pipelined. The application nature of the data flow graph model allows flexible scheduling of the execution of enabled instructions in the pipeline data flow programs. Accordingly, program transformation can be performed on the basis of both the global and local data flow analysis to generate efficient pipelined data flow machine code. A pipelined code mapping scheme for transforming array operations in high-level language programs into pipelined data flow machine programs is described. Author

N88-18255# Northwestern Univ., Evanston, Ill.
AUTOMATED DATA FLOW DIAGRAM VERIFICATION
Reva Friedman, Waldo C. Kabat, and Wojtek Kozaczynski (Illinois

Univ., Chicago.) *In* North Carolina Univ., Proceedings of the Workshop on Future Directions in Computer Architecture and Software 30 Aug. 1986 p 370-371 (For primary document see N88-18191 10-60)
Avail: NTIS HC A18/MF A01 CSCL 09B

An initial implementation of an interactive Automated Data Flow Diagram Verification system (ADFDV) is described. ADFDV is a component of the larger system called System Analyst's Apprentice (SAA). SAA is being developed to assist an analyst in different phases of Computer Information System (CIS) design and development. The ADFDV is a tool for mechanical checking of Data Flow Diagrams (DFD) for correctness. The philosphy behind the system is to assist the analyst in the error-prone job of the verification of Data Flow Diagrams for large programming projects. Structured Analysis and Design (SAD) techniques have been used to avoid errors that may have an impact on the quality of final CIS design. Author

N88-18256# Indiana Univ., Bloomington. Dept. of Computer Science.
FINELY GRAINED PARALLELISM IN AN APPLICATIVE ARCHITECTURE
John T. ODonnell *In* North Carolina Univ., Proceedings of the Workshop on Future Directions in Computer Architecture and Software 30 Aug. 1986 p 372-374 (For primary document see N88-18191 10-60)
Avail: NTIS HC A18/MF A01 CSCL 09B

The Applicative Programming System Architecture (APSA) research project is developing new ways to use finely grained parallel architectures to support applicative programming languages. The goal is a parallel machine that is easily programmable with LISP-like language. The programmer does not need to control the parallelism explicitly. Instead, the system provides a number of rich types of data structure with parallel operations that perform complex operations on the data structures. Some of these data structures are used by the language interpreter, and others are available to the programmer. Even a programmer who does not directly use any of the parallel data structures will benefit from the system because the language interpreter itself uses parallel data structure operations to run faster. This approach ensures that programs can actually make use of the architecture's power and it greatly eases the burden of writing parallel programs. Author

N88-18257# Carnegie-Mellon Univ., Pittsburgh, Pa. Dept. of Computer Science.
FUTURE DIRECTIONS IN COMPUTER ARCHITECTURE
E. Douglas Jensen *In* North Carolina Univ., Proceedings of the Workshop on Future Directions in Computer Architecture and Software 30 Aug. 1986 p 380-382 (For primary document see N88-18191 10-60)
Avail: NTIS HC A18/MF A01 CSCL 09B

Following is a brief outline of a recommendation concerning one future direction which computer architecture ought to take. The focus is on reducing the preponderant evolvability and interoperability component of life cycle costs for real-time C3/battle management computer systems, through greatly improved architectural (particularly processor) modularity; and additional cost/performance contribution by such modularity is the enhanced feasibiliy of architectural algorithmic specialization (an important capability despite the misunderstandings of RISC proponents). Author

N88-18258# Army Research Office, Research Triangle Park, N.C.
FUTURE DIRECTIONS IN COMPUTER ARCHITECTURE AND SOFTWARE WORKSHOP
J. R. Burke *In* North Carolina Univ., Proceedings of the Workshop on Future Directions in Computer Architecture and Software 30 Aug. 1986 p 383-386 (For primary document see N88-18191 10-60)
Avail: NTIS HC A18/MF A01 CSCL 09B

Interconnection networks are required to provide communication links in a multiprocessor computer system. Whether such networks are static or dynamic, their throughput can become a bottleneck when the number of processors is large. The paper Image Texture Classification with an Optical Crossbar Interconnected Processor, in the Interconnection Strategies session describes a development which may overcome this bottleneck. The crossbar is effected optically and dynamically using, for example, lenses or acousto-optic gratings to determine the optical path between an array of laser diodes (representing sources) and an array of photodiodes (representing destinations). Messages would be passed by modulation of the laser diodes. Author

N88-18259*# New York State Univ., Albany. Dept. of Physics.
INVESTIGATIONS ON THE USEFULNESS OF THE MASSIVELY PARALLEL PROCESSOR FOR STUDY OF ELECTRONIC PROPERTIES OF ATOMIC AND CONDENSED MATTER SYSTEMS Final Report, 15 Aug. 1986 - 14 Aug. 1987
T. P. Das 1988 13 p
(Grant NAG5-836)
(NASA-CR-182514; NAS 1.26:182514) Avail: NTIS HC A03/MF A01 CSCL 09B

The usefulness of the Massively Parallel Processor (MPP) for investigation of electronic structures and hyperfine properties of atomic and condensed matter systems was explored. The major effort was directed towards the preparation of algorithms for parallelization of the computational procedure being used on serial computers for electronic structure calculations in condensed matter systems. Detailed descriptions of investigations and results are reported, including MPP adaptation of self-consistent charge extended Hueckel (SCCEH) procedure, MPP adaptation of the first-principles Hartree-Fock cluster procedure for electronic structures of large molecules and solid state systems, and MPP adaptation of the many-body procedure for atomic systems. J.P.B.

N88-18260# Illinois Univ., Urbana. Center for Supercomputing Research and Development.
A MEASUREMENT-BASED STUDY OF CONCURRENCY IN A MULTIPROCESSOR M.S. Thesis
Patrick John McGuire Jan. 1987 59 p
(Contract DE-FG02-85ER-25001; Grant NSF DCR-84-10110)
(DE88-003536; DOE/ER-25001/94; CSRD-674; UILU-ENG-87-2210) Avail: NTIS HC A04/MF A01

This thesis develops a systematic measurement-based methodology for characterizing the amount of concurrency present in a workload, and the effect of concurrency on system performance indices such as cache miss rate and bus activity. Hardware and software instrumentation of an Alliant FX/8 at the University of Illinois Center for Supercomputing Research and Development was used to obtain data from a real workload environment. Results show that 35 percent of the workload is concurrent, with the concurrent periods typically using all available processors. Measurements of periods of change in concurrency show uneven usage of processors during these times. Other system measures, including cache miss rate and processor bus activity, are analyzed with respect to the concurrency measures. Probability of a cache miss is seen to increase with concurrency. The change in the cache miss is much more sensitive to the fraction of concurrent code in the workload than the number of processors active during concurrency. Regression models are developed to quantify the relationships between cache miss rate, bus activity and the concurrency measures. The model for cache miss rate predicts an increase in the median miss rate values of an much as 300 percent for a 100 percent increase in concurrency in the workload. DOE

N88-18261# Illinois Univ., Urbana. Center for Supercomputing Research and Development.
A PERFORMANCE ANALYSIS OF ARCHITECTURAL SCALABILITY Ph.D. Thesis
Alex Yuen-Wai Kwok Aug. 1987 232 p Sponsored in part by IBM Corp. and Digital Equipment Corp.

(Contract DE-FG02-85ER-25001; Grant NSF DCR-84-10110)
(DE88-003537; DOE/ER-25001/95; CSRD-679;
UILU-ENG-86-8006) Avail: NTIS HC A11/MF A01

The peak performance of a multiprocessor system is rarely attainable. Algorithm penalty, interprocessor communication cost, and synchronization overhead are major factors limiting the performance scalability. The MPPP is a trace driven simulation facility developed for the performance prediction of large scale multiple vector-processor systems. This facility, when used with the Parafrase program restructurer, provides a powerful tool for studying the performance of parallel Fortran programs under variations of architecture, system, and workload parameters. Using the MPPP facility, we analyze the performance scalability issue at three different levels: the algorithm restructuring level, the compiler optimization level, and the machine organization level. Johnsson's narrow banded linear systems solver, the fast Fourier transform, the preconditioned conjugate gradient method, and the Gaussian elimination with pivoting algorithm were used as sample workload in our analysis. DOE

N88-18262# California Inst. of Tech., Pasadena.
EMERGING SUPERCOMPUTER ARCHITECTURES
P. C. Messina 1987 37 p
(Contract DE-FG03-85ER-25009)
(DE88-003539; DOE/ER-25009/449) Avail: NTIS HC A03/MF A01

This paper will examine the current and near future trends for commercially available high-performance computers with architectures that differ from the mainstream supercomputer systems in use for the last few years. These emerging supercomputer architectures are just beginning to have an impact on the field of high performance computing. DOE

N88-18263# California Inst. of Tech., Pasadena.
FEATURES OF A TERAFLOP SUPERCOMPUTER
G. C. Fox and A. Frey Aug. 1987 37 p Sponsored in part by IBM Corp., Sandia Labs., The Parson's Foundation, and System Development Foundation
(Contracts DE-FG03-85ER-25009; DE-AC03-85ER-40050)
(DE88-003540; DOE/ER-25009/451) Avail: NTIS HC A03/MF A01

We consider architectural, application, and software issues for the coarse grain distributed and shared memory concurrent computers, currently typified by the hypercubes, transputer arrays, the RP3 and BBN Butterfly, and summarize some of the lessons learned from several years of study. Based on these considerations we discuss the possibility of building a supercomputer with a maximum configuration that could sustain performance in the range of 10 to the 12th power floating point operations per second with a memory of order 10 to the 12th power bytes. We show how lessons from the use of current machines indicate that good performance would be obtained on a wide range of scientific problems. We suggest how such a machine could be built in the next few years with current technology. DOE

N88-18264# Du Pont de Nemours (E. I.) and Co., Aiken, S.C.
PERSONAL COMPUTERS AND ALL-IN-1: DOCUMENT TRANSFER AND TRANSLATION
C. F. Stanland 1987 6 p Presented at the Digital Equipment Computer Users Society Fall Symposium, Anaheim, Calif., 7 Dec. 1987
(Contract DE-AC09-76SR-00001)
(DE88-003760; DP-MS-87-141; CONF-871248-1) Avail: NTIS HC A02/MF A01

The Savannah River site is currently utilizing a multi-vendor approach to provide Office Automation. Personal computer workstations include the Apple Mackintosh, IBM PC, DEC Rainbow and DEC VAXmate. Users of these workstations typically employ a variety of word processing and graphics packages to produce documents, many of which need to be exchanged in revisable form with users of different word processing packages. Since most of these users are utilizing terminal emulators to access the departmental ALL-IN-1 systems, the need/desire to translate and/or transfer workstation-created documents via electronic mail naturally arose. We will discuss our enhancements to document transfer capabilities of ALL-IN-1 to support host-initiated file transfer to and from any of the above mentioned workstations. Documents, including attachments, may be uploaded to, or downloaded from, ALL-IN-1 in their native format or with conversion. Document conversions are performed transparently using ALL-IN-1 DSAB's or third party packages with attributes such as rulers, soft returns, bolding, and underscoring preserved. Support for translation independent of transfer is also provided and a Get From Personal Computer option has been added to the editor menus. DOE

N88-18265# Los Alamos National Lab., N. Mex.
VECTOR PERFORMANCE OF REGISTER-TO-REGISTER VECTOR COMPUTERS
I. Y. Bucher Jan. 1988 33 p
(Contract W-7405-eng-36)
(DE88-004013; LA-11198-MS) Avail: NTIS HC A03/MF A01

Advances in compiler technology have changed the vector performance characteristics of register-to-register vector computers. The paper compares measurements under carefully controlled conditions on a single processor of the CRAY X-MP with existing performance models. Vector startup times are context dependent and can be negative. Memory access contentions lead to significant performance degradations even with a single processor. Our simulation studies reproduce the measured results and point to possible improvements. A new performance model is introduced that adequately represents vector performance of present register-to-register vector computers. DOE

N88-18266# Los Alamos National Lab., N. Mex.
SUPERCOMPUTER PERFORMANCE: THE THEORY, PRACTICE, AND RESULTS
O. M. Lubeck, ed. and E. A. Shapar, ed. Jan. 1988 62 p
(Contract W-7405-eng-36)
(DE88-004697; LA-11204-MS) Avail: NTIS HC A04/MF A01

The National Research Council, in a recent report on supercomputer performance, has noted that supercomputer performance measurements fall in a hierarchy of measurement tests. The hierarchy spans benchmarks ranging from low-dimensional demonstration loops to highly integrated full application codes. This paper surveys recent performance measurements of supercomputers from numerous sources in the framework of this hierarchy. A critical evaluation of specific benchmark practices is presented, and the possible reasons for misinterpretation of benchmark results is discussed. The current state of vectorized workloads is also surveyed and the future of vectorization in supercomputer architectures is considered. DOE

N88-18267*# Illinois Univ., Urbana-Champaign. Coordinated Science Lab.
TABLET: THE PERSONAL COMPUTER OF THE YEAR 2000
Bartlett W. Mel, Stephen M. Omohundro, Arch D. Robison, Steven S. Skiena, Kurt H. Thearling, Luke T. Young, and Stephen Wolfram Feb. 1988 34 p
(Grant NAG1-613)
(NASA-CR-182528; NAS 1.26:182528; UILU-ENG-88-2214;
CSG-85) Avail: NTIS HC A03/MF A01 CSCL 09B

The University of Illinois design of the TABLET portable computer extends the freedom of pen and notepad with a machine that draws on the projected power of 21st century technology. Without assuming any new, major technological breakthroughs, it seeks to balance the promises of today's growing technologies with the changing role of computers in tomorrow's education, research, security, and commerce. It seeks to gather together in one basket the matured fruits of such buzzword technologies as LCD, GPS, CCD, WSI, and DSP. The design is simple, yet sleek. Roughly the size and weight of a notebook, the machine is a dark, featureless monolith with no moving parts. Through magneto-optics, a simple LaserCard provides exchangeable, mass data storage. Its I/O surface, in concert with built-in infrared and cellular transceivers, puts the user in touch with anyone and anything. The ensemble of these components, directed by software

that can transform it into anything from a keyboard or notepad to an office or video studio, suggests an instrument of tremendous power and freedom. Author

N88-18268# Honeywell, Inc., Bloomington, Minn. Physical Sciences Center.
OPTICAL SYMBOLIC PROCESSOR FOR EXPERT SYSTEM EXECUTION Quarterly Technical Report, 1 Jun. - 31 Aug. 1987
Aloke Guha, Subra Natarajan, and Matthew Derstine 31 Aug. 1987 33 p
(Contract F49620-86-C-0082; ARPA Order 5794)
(AD-A187494; AFOSR-87-1646TR) Avail: NTIS HC A03/MF A01 CSCL 12F

The goal of this program is to develop a concept for an optical computer architecture for symbolic computing by defining a computation model of a high level language, examining the possible devices for the ultimate construction of a processor, and by defining required optical operations. A detailed evaluation of the optical architecture (SPARO) for combinator graph reduction was undertaken. Since it was determined that the interconnection network was the bottleneck in the performance of the architecture, the focus was on the message throughput of the simple register-based network. An accurate performance model was derived for the equivalent bidirectional ring network and it was found that the net parallelism in the architecture was indeed restricted by the low message traffic in the network. When messages exhibit no locality, the throughput for a 1024 processor network is limited to 8. With local messages, the maximum throughput for the same network is 27. All results were subsequently verified by simulations. GRA

N88-18269# Naval Underwater Systems Center, New London, Conn.
SYSTOLIC ARRAY ADAPTIVE BEAMFORMING
Norman L. Owsley 21 Sep. 1987 35 p
(AD-A187496; NUSC-TR-7981) Avail: NTIS HC A03/MF A01 CSCL 12F

A computing architecture which reflects the specific requirements of an optimum adaptive space-time array processor is discussed. Specifically, a frequency domain implementation of the minimum variance distortionless response (MVDR) beamformer is described. Two systolic computing arrays are presented which implement respectively a rank one update of the Cholesky factor for a spatial sensor array cross-spectral covariance matrix and the solution of a set of linear equations for the optimum array matrix filter beamformer operation. The theoretical performance of the MVDR beamformer is reviewed. Finally, an array partitioning approach permits the application of systolic MVDR beamforming to arrays with very large numbers of sensors is proposed. Two sub-optimum MVDR processes are considered which exhibit nearly optimum performance at high interference-to-noise ratios. GRA

61 COMPUTER PROGRAMMING AND SOFTWARE

Includes computer programs, routines, alogorithms, and specific applications, e.g., CAD/CAM.

N88-18270# Naval Postgraduate School, Monterey, Calif.
EXPERIENCE WITH OMEGA: IMPLEMENTATION OF A PROTOTYPE PROGRAMMING ENVIRONMENT, PART 6
Bruce J. MacLennan Sep. 1987 74 p
(AD-A187080; NPS52-87-042-Pt-6) Avail: NTIS HC A04/MF A01 CSCL 09B

This is the last report of a series exploring the use of the Omega programming notation to prototype a programming environment. This environment includes an interpreter, unparser, syntax directed editor, command interpreter, debugger and code generator, and supports programming in a small applicative language. This report presents a universal (i.e., table-driven) syntax directed editor and unparser, which requires only 53 rules to express. A running implementation of these ideas is listed in the appendices. GRA

N88-18271# Cornell Univ., Ithaca, N.Y. Mathematical Sciences Inst.
ANNOTATED COMPUTER OUTPUT FOR SPLIT PLOT DESIGN: GENSTAT ANOVA Interim Technical Report
W. T. Federer, Z. D. Feng, and N. J. Miles-McDermott 10 Aug. 1987 21 p
(Contract DAAG29-85-C-0018)
(AD-A187120; ARO-23306.100-MA) Avail: NTIS HC A03/MF A01 CSCL 09B

In order to provide an understanding of covariance analyses for split plot designs, analyses are first conducted on a data set without the covariate. Then an analysis with the covariate is performed. The third example has a different experiment design for the whole plots and the covariate is constant for all split plots within a whole plot. Computer packages may only give portions of the analysis correctly. Some packages require two procedural calls to obtain a portion of the correct results. GENSTAT requires only one procedural call. GRA

N88-18272*# National Aeronautics and Space Administration. Langley Research Center, Hampton, Va.
PARAMETER IDENTIFICATION AND SENSITIVITY ANALYSIS FOR A ROBOTIC MANIPULATOR ARM Final Report
D. W. Brewer and J. S. Gibson 3 Oct. 1980 31 p Submitted for publication
(Contract NAS1-18107)
(NASA-CR-181608; ICASE-88-1; NAS 1.26:181608) Avail: NTIS HC A03/MF A01 CSCL 09B

The development of a nonlinear dynamic model for large oscillations of a robotic manipulator arm about a single joint is described. Optimization routines are formulated and implemented for the identification of electrical and physical parameters from dynamic data taken from an industrial robot arm. Special attention is given to difficulties caused by the large sensitivity of the model with respect to unknown parameters. Performance of the parameter identification algorithm is improved by choosing a control input that allows actuator emf to be included in an electro-mechanical model of the manipulator system. Author

N88-18273# Massachusetts Inst. of Tech., Cambridge. Lab. for Computer Science.
FX-87 REFERENCE MANUAL, EDITION 1.0
David K. Gifford, Pierre Jouvelot, John M. Lucassen, and Mark A. Sheldon Sep. 1987 165 p
(Contract N00014-83-K-0125)
(AD-A187031; MIT/LCS/TR-407) Avail: NTIS HC A08/MF A01 CSCL 12E

The FX programming language is designed to support the parallel implementation of applications that perform both symbolic and scientific computations. Unlike previous languages, FX uses an effect system to discover expression scheduling constraints. The effect system is part of a kinded type system with three base kinds: types, which describe the value of an expression: effects, which describe the side-effects that an expression may have; and regions, which describe the areas of the store in which side-effects may occur. Types, effects and regions are effectively called descriptions. FX expressions can be abstracted over any kind of description. This permits type, effect and region polymorphism. Unobserved side-effects are masked by the effect system; an effect soundness property guarantees that the effects computed statically by the effect system are a conservative approximation of the actual side-effects that a given expression may have. Effect polymorphism and effect masking make the FX effect system substantially more powerful than previous approaches to side-effect analysis. GRA

N88-18274# Illinois Univ., Urbana. Center for Supercomputing Research and Development.
THE IMPACT OF HIERARCHICAL MEMORY SYSTEMS ON LINEAR ALGEBRA ALGORITHM DESIGN

K. Gallivan, W. Jalby, U. Meier, and A. Sameh 14 Sep. 1987 64 p
(Contract DE-FG02-85ER-25001)
(DE88-003574; DOE/ER-25001/38) Avail: NTIS HC A04/MF A01

Performing an extremely detailed performance optimization analysis is counterproductive when the concern is performance behavior on a class of architecture, since general trends are obscured by the overwhelming number of machine-specific considerations required. Instead, a methodology is used which identifies the effects of a hierarchical memory system on the performance of linear algebra algorithms on multivector processors; provides a means of producing a set of algorithm parameters, i.e., blocksizes, as functions of system parameters which yield near-optimal performance; and provides guidelines for algorithm designers which reduce the influence of the hierarchical memory system on algorithm performance to negligible levels and thereby allow them to concentrate on machine-specific optimizations. The remainder of this paper comprises five major discussions. First, the methodology and the attendant architectural model are discussed. Next, an analysis of the basic BLAS3 matrix-matrix primitive is presented. This is followed by a discussion of three block algorithms: a block LU decomposition, a block LDL(sup T) decomposition and a block Gram-Schmidt algorithm. DOE

N88-18275# Illinois Univ., Urbana. Center for Supercomputing Research and Development.
PSolve: A CONCURRENT ALGORITHM FOR SOLVING SPARSE SYSTEMS OF LINEAR EQUATIONS
T. A. Davis and E. S. Davidson 1987 8 p Presented at the International Conference on Parallel Processing, St. Charles, Ill., 17 Aug. 1987
(Contract DE-FG02-85ER-25001)
(DE88-003584; DOE/ER-25001/73; CONF-870831-11) Avail: NTIS HC A02

PSolve solves a sparse system of linear equations on a shared-memory parallel processor. Each autonomous process reduces a pair of matrix rows, uses pairwise pivoting for numerical stability, and synchronizes with only a few others at a time. For most test matrices, on the Alliant FX/8 multiprocessor, PSolve is faster than Gaussian Elimination (does not exploit sparsity) and the Yale Sparse Matrix Package (does not exploit parallelism). Although Gaussian Elimination runs in vector mode, PSolve cannot use currently available vector hardware because of its compact matrix storage scheme. However, with a new sparse-align vector unit, PSolve is vectorizable and runs faster than any other algorithm for all the selected test matrices. DOE

N88-18276# Illinois Univ., Urbana. Center for Supercomputing Research and Development.
DEBUGGING FORTRAN ON A SHARED MEMORY MACHINE
T. R. Allen and D. A. Padua 1987 8 p Presented at the International Conference on Parallel Processing, St. Charles, Ill., 17 Aug. 1987
(Contract DE-FG02-85ER-25001)
(DE88-003589; DOE/ER-25001/37; CONF-870831-6) Avail: NTIS HC A02

Debugging on a parallel processor is more difficult than debugging on a serial machine because errors in a parallel program may introduce nondeterminism. The approach to parallel debugging presented here attempts to reduce the problem of debugging on a parallel machine to that of debugging on a serial machine by automatically detecting nondeterminism. DOE

N88-18277# Stanford Univ., Calif. Systems Optimization Lab.
ELIMINATING COLUMNS IN THE SIMPLEX METHOD FOR LINEAR PROGRAMMING
Yinyu Ye Nov. 1987 14 p
(Contract DE-FG03-87ER-25028)
(DE88-004191; SU-SOL-87-14) Avail: NTIS HC A03/MF A01

In this paper we pose and answer two questions about solutions of the linear complementarity problem (LCP). The first question is concerned with the conditions on a square matrix M which guarantee that for every vector q, the solutions of LCP (q,M) are identical to the Karush-Kuhn-Tucker points of the natural quadratic program associated with (q,M). In answering this question we introduce the class of row sufficient matrices. The transpose of such a matrix is what we call column sufficient. The latter matrices turn out to furnish the answer to our second question which asks for the conditions on M under which the solution set of (q,M) is convex for every q. In addition to these two main results, we discuss the connections of these two new matrix classes with other well-known matrix classes in linear complementarity theory. DOE

N88-18278# Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of High Energy.
MICRO SYSTEM FOR CONTROL, ACQUISITION AND PROCESSING OF EXPERIMENTAL DATA
V. G. Dudnikov 1986 12 p In RUSSIAN
(DE88-700724; JINR-R-10-86-751) Avail: NTIS (US Sales Only) HC A03/MF A01

The Micro on-line module system (MS) for experimental data control, acquisition and processing is described. The Micro system is designed for developing the ionization electron-beam method, for construction and improvement of the cryogenic ionizers of the Cryon type. The Micro MS is made in the CAMAC standard and besides a standard crate highway contains two types of additional highways: general (global) and local for every microcomputer placed in the crate. The transmission of the Micro MS increases 5 to 10 times in comparison with the MS analogous in composition, operating in the CAMAC standard. The first experiments studying X-ray radiation at the Cryon-2 ionizer have shown advisability of the presence of several highways in the Micro MS. DOE

N88-18279*# National Aeronautics and Space Administration. Langley Research Center, Hampton, Va.
INTRODUCTION TO A SYSTEM FOR IMPLEMENTING NEURAL NET CONNECTIONS ON SIMD ARCHITECTURES Final Report
Sherryl Tomboulian Jan. 1988 16 p Submitted for publication
(Contract NAS1-18107)
(NASA-CR-181612; ICASE-88-3; NAS 1.26:181612) Avail: NTIS HC A03/MF A01 CSCL 09B

Neural networks have attracted much interest recently, and using parallel architectures to simulate neural networks is a natural and necessary application. The SIMD model of parallel computation is chosen, because systems of this type can be built with large numbers of processing elements. However, such systems are not naturally suited to generalized communication. A method is proposed that allows an implementation of neural network connections on massively parallel SIMD architectures. The key to this system is an algorithm permitting the formation of arbitrary connections between the neurons. A feature is the ability to add new connections quickly. It also has error recovery ability and is robust over a variety of network topologies. Simulations of the general connection system, and its implementation on the Connection Machine, indicate that the time and space requirements are proportional to the product of the average number of connections per neuron and the diameter of the interconnection network. Author

N88-18280# Amsterdam Univ. (Netherlands). Dept. of Computer Science.
MACHINE MODELS AND SIMULATIONS
P. vanEmdeBoas 1987 66 p
(PB88-118690; FVI-87-01) Avail: NTIS HC A04/MF A01 CSCL 09B

In Complexity Theory, the use of informal estimates can be justified by appealing to the Invariance Thesis which states that all standard models of sequential computing devices are equivalent in the sense that the fundamental complexity classes don't depend on the precise model chosen for their definition. Similarly, the Parallel Computation Thesis states that parallel models have polynomially related time measures and that, moreover, parallel time is polynomially equivalent to sequential space. A survey on the wold of machine models and the simulations between them is

given. The sequential models satisfying the invariance thesis are gathered into a first machine class and the parallel models which satisfy the parallel computation thesis into a second machine class. This seems not to exhaust all machine models proposed in the literature, not even all models which are introduced as being reasonable. The survey takes us from the weakest universal models considered by mathematicians to the most powerful models considered today where time stops to be a complexity measure.
Author

N88-18281# Tilburg Univ. (Netherlands). Dept. of Economics.
CONTINUOUS DEFORMATION ALGORITHM ON THE PRODUCT SPACE OF UNIT SIMPLICES, REVISED VERSION
T. M. Doup and A. J. J. Talman May 1986 74 p Sponsored by Nederlandse Organisatie voor Zuiver Wetenschappelijk Onderzoek, The Hague
(PB88-114210; FEW-219) Avail: NTIS HC A04/MF A01
CSCL 09B

A continuous deformation algorithm is introduced on S x (the internal is less than or = to 1, but less than infinity), where S denotes the product space of unit simplices, with arbitrary grid refinement between two subsequent levels. The set S x (the interval is less than or = to 1, but less than infinity) is triangulated by the so-called V-triangulation. The algorithm starts by applying a variable dimension algorithm on S until an approximating simplex was found on level 1. Then the algorithm follows a path of approximating simplices in S x (the internal is less than or = to 1, but less than infinity), starting on level 1, until a certain level or a certain accuracy of a solution of the underlying problem was reached. If the algorithm returns to level 1, then the variable dimension algorithm is applied until a new approximating simplex is found on level 1. The solution are allowed to lie on the boundary of S x (the internal is less than or = to 1, but less than infinity) in which case the algorithm, in general, will follow a path on the boundary of S x (the interval is less than or = to 1, but less than infinity). GRA

N88-18282# Illinois Univ., Urbana. Center for Supercomputing Research and Development.
USING PROGRAM STRUCTURE TO ACHIEVE PREFETCHING FOR CACHE MEMORIES Ph.D. Thesis
G. A. Brent Jan. 1987 179 p
(Contract DE-FG02-85ER-25001)
(DE88-003599; DOE/ER-25001/43; UILU-ENG-87-8001; CSRD-647) Avail: NTIS HC A09/MF A01

A concise program structure notation, called a program skeleton, is developed that can be used for program analysis or, if machine-specific details are included, for memory prefetching. The program skeleton describes the structure of the source code as well as the low-level accessing behavior. Transformations are developed to create a machine-specific cache memory prefetching control program, called the prefetch skeleton (PFS), from the program skeleton. A prefetching unit (PFU) is developed as a simple in-cache processor. The PFU executes the PFS and generates cache line prefetch requests ahead of CPU demand requests. A variety of PFS-cache machines are simulated in detail to demonstrate the feasibility of the PFS prefetcher. Instruction miss delays can be reduced significantly by using a PFS-cache. Some reduction in data miss delays is also obtained even though the PFS as developed in this initial research focuses primarily on instruction prefetching. The PFS prefetching scheme improves cache performance without requiring programmer involvement, since the PFS is generated automatically by the compiler as it compiles the source program. The PFS concept is compatible with a variety of programming languages. The PFS-cache machine is capable of running non-PFS programs, although better performance is obtained when the programs are recompiled to create the PFS. DOE

N88-18283# Lawrence Livermore National Lab., Calif.
GRAPH TRANSFORMATION ALGORITHMS FOR ARRAY MEMORY OPTIMIZATION IN APPLICATIVE LANGUAGES Ph.D. Thesis
J. E. Ranelletti Nov. 1987 221 p
(Contract W-7405-eng-48)
(DE88-004727; UCRL-53832) Avail: NTIS HC A10/MF A01

In applicative language implementations, the potential copying of array elements can severely restrict the efficiency of the run-time code. In many instances, copy avoidance can be achieved through memory preallocation. This Ph.D. dissertation presents a compile-time graph algorithm strategy, for use with the SISAL programming language, that identifies cases where preallocating memory storage locations for array aggregates is possible. The preallocation actions to be taken are specified by providing intermediate language graph transformations that designate the run-time creation of memory buffers prior to array creation. The preallocation analysis algorithms predict a significant savings in the execution time of selected sample programs; more than 90 percent of the array copying operations can be removed from existing unoptimized implementations. The results indicate that array memory allocation for some applicative language programs can be efficient. DOE

N88-18284# Sandia National Labs., Albuquerque, N. Mex.
CUEMAP: A TOOL FOR GENERATING HIERARCHICAL CHARTS AND DATAFLOW DIAGRAMS
J. W. Lee Dec. 1987 15 p
(Contract DE-AC04-76DP-00789)
(DE88-004778; SAND-87-1414) Avail: NTIS HC A03/MF A01

CUEMAP is a preprocessor to the MAPPER program, which generates report quality visual aids. CUEMAP uses text blocks, symbols, and line connectors to lay out hierarchical charts and dataflow diagrams. A grid is specified as a reference point on which the labels and symbols can be placed. Connectors are added to complete the diagram. Modifications and enhancements require knowledge of the MAPPER syntax. DOE

N88-18285# Groningen Rijksuniversiteit (Netherlands). Subfaculteit Wiskunde en Informatica.
NON-MYTHICAL GENERALIZATION OF DEKKER'S ALGORITHM AND ITS RAMIFICATIONS
J. T. Udding and W. Chen Feb. 1987 16 p Sponsored by Washington Univ., St. Louis, Mo.
(PB88-126321; CS-8702) Avail: NTIS HC A03/MF A01
CSCL 09B

Numerous algorithms exist to ensure mutual exclusion between processes. In the paper the authors introduce yet another algorithm, the presentation of which the authors think is justified for two reasons. First of all, it is a genuinely straightforward generalization of Dekker's algorithm to an arbitrary number of processes. The algorithm is very simple and a process can be forced to wait at most once for every other process before being able to enter its critical section. Secondly, applying the same generalization technique to neighboring processes only, a solution to the Dining Philosophers Problem on a ring of processes of arbitrary number is easily derived. It is shown that the length of a contiguous string of blocked philosophers can be no more than 4. GRA

N88-18286# Foersvarets Forskingsanstalt, Stockholm (Sweden).
IMPLEMENTATION OF ENCODERS AND DECODERS FOR REED-SOLOMON CODES
M. Skoglund Sep. 1987 64 p
(PB88-126628; FOA-C-30471-3.3) Avail: NTIS HC A04/MF A01 CSCL 09B

The authors show that it is possible to use a simple and cheap 8-bit microprocessor for implementation of rather complex error correcting coding methods and that it is possible to use this implementation for information rates up to 10 kbit/s. The authors also show what improvements of the bit error probability one can expect for some information rates by using these error correcting codes and their implementation. GRA

N88-18287# Argonne National Lab., Ill.
PROGRAMMING METHODOLOGY AND PERFORMANCE ISSUES FOR ADVANCED COMPUTER ARCHITECTURES
J. J. Dongarra, D. C. Sorensen, K. Connolly, and J. Patterson

1987 31 p Presented at the Vector and Parallel Processing in Computational Science, Liverpool, United Kingdom, 25 Aug. 1987
(Contract W-31-109-eng-38)
(DE88-003098; CONF-8708148-2) Avail: NTIS HC A03/MF A01

This paper will describe some recent attempts to construct transportable numerical software for high performance computers. Restructuring algorithms in terms of simple linear algebra modules is reviewed. This technique has proved very successful in obtaining a high level of transportability without severe loss of performance on a wide variety of both vector and parallel computers. The use of modules to encapsulate parallelism and reduce the ratio of data movement to floating point operations has been demonstrably effective for regular problems such as those found in dense linear algebra. In other situations it may be necessary to express explicitly parallel algorithms. We also present a programming methodology that is useful for constructing new parallel algorithms which require sophisticated synchronization at a large grain level. We describe the SCHEDULE package which provides an environment for developing and analyzing explicitly parallel programs in FORTRAN which are portable. This package now includes a preprocessor to achieve complete portability of user level code and also a graphics post processor for performance analysis and debugging. We discuss details of porting both the SCHEDULE package and user code. DOE

N88-18288# Illinois Univ., Urbana. Center for Supercomputing Research and Development.
A MULTIPROCESSOR SCHEME FOR THE SINGULAR VALUE DECOMPOSITION
M. Berry and A. Sameh Aug. 1987 10 p Presented at the 3rd SIAM Conference on Parallel Processing for Scientific Computing, Los Angeles, Calif., 1 Dec. 1987
(Contract DE-FG02-85ER-25001)
(DE88-003591; DOE/ER-25001/52; CONF-871251-2) Avail: NTIS HC A02/MF A01

A multiprocessor scheme is presented for determining the singular value decomposition of rectangular matrices in which the number of rows is substantially large (or smaller) than the number of columns. An initial QR factorization is performed on the tall matrix (either A or A(sup T)) using a multiprocessor block Householder algorithm. A parallel one-sided Jacobi scheme is then used to orthogonalize the columns of the upper triangular matrix R to yield the factorization RV = U Sigma, from which the desired singular value decomposition is obtained. Preliminary experiments on an Alliant FX/8 computer system with 8 processors indicate speedups near 5 for the scheme over an optimized implementation of the Linpack/Eispack routines which perform the classical bi-diagonalization technique. The scheme performs exceptionally well for rank deficient matrices as well as for those rectangular matrices having clustered or multiple singular values, and may be well suited for applications such as real-time signal processing. Performance results on the Alliant FX/8 and Cray X-MP/48 computer systems are presented with particular emphasis on speed ups obtained for our scheme over classical SVD algorithms. DOE

N88-18289*# Illinois Univ., Urbana-Champaign. Coordinated Science Lab.
EXPERIENCES WITH SERIAL AND PARALLEL ALGORITHMS FOR CHANNEL ROUTING USING SIMULATED ANNEALING
Randall Jay Brouwer Feb. 1988 59 p
(Grant NAG1-613)
(NASA-CR-182530; NAS 1.26:182530; UILU-ENG-88-2213; CSG-84) Avail: NTIS HC A04/MF A01 CSCL 09B

Two algorithms for channel routing using simulated annealing are presented. Simulated annealing is an optimization methodology which allows the solution process to back up out of local minima that may be encountered by inappropriate selections. By properly controlling the annealing process, it is very likely that the optimal solution to an NP-complete problem such as channel routing may be found. The algorithm presented proposes very relaxed restrictions on the types of allowable transformations, including overlapping nets. By freeing that restriction and controlling overlap situations with an appropriate cost function, the algorithm becomes very flexible and can be applied to many extensions of channel routing. The selection of the transformation utilizes a number of heuristics, still retaining the pseudorandom nature of simulated annealing. The algorithm was implemented as a serial program for a workstation, and a parallel program designed for a hypercube computer. The details of the serial implementation are presented, including many of the heuristics used and some of the resulting solutions. Author

N88-18290# Carnegie-Mellon Univ., Pittsburgh, Pa. Software Engineering Inst.
A METHOD FOR ASSESSING THE SOFTWARE ENGINEERING CAPABILITY OF CONTRACTORS: PRELIMINARY VERSION Final Report
W. S. Humphrey and W. L. Sweet Sep. 1987 46 p
(Contract F19628-85-C-0003)
(AD-A187230; CMU/SEI-87-TR-23; ESD-TR-87-186) Avail: NTIS HC A03/MF A01 CSCL 12E

This document provides guidelines and procedures for assessing the ability of potential DOD contractors to develop software in accordance with modern software engineering methods. It includes specific questions and a method for evaluating the results. GRA

N88-18291# Carnegie-Mellon Univ., Pittsburgh, Pa. Software Engineering Inst.
FACTORS CAUSING UNEXPECTED VARIATIONS IN Ada BENCHMARKS Final Report
Neal Altman Oct. 1987 45 p
(Contract F19628-85-C-0003)
(AD-A187231; CMU/SEI-87-TR-22; ESD-TR-87-173) Avail: NTIS HC A03/MF A01 CSCL 12G

One of the goals of the Ada Embedded Systems Testbed (AEST) Project is to assess the readiness of the Ada programming language and Ada tools for developing embedded systems. The benchmarking and instrumentation subgroup within AEST Project is running various suites of Ada benchmarks to obtain data on the real-time performance of Ada on a number of different target systems. The purpose of this report is to categorize the factors that have been observed, while others are more speculative in nature. All these factors should be understood if accurate, comparable, and repeatable performance data are to be produced by Ada benchmarks. GRA

N88-18292# Air Force Inst. of Tech., Wright-Patterson AFB, Ohio.
DEVELOPMENT OF A GRAPHICS BASED TWO-ATTRIBUTE UTILITY ASSESSMENT PROGRAM WITH APPLICATION TO MISSION PLANNING M.S. Thesis
Eleonore H. Wanner Dec. 1986 195 p
(AD-A187276; AFIT/CI/NR-87-73T) Avail: NTIS HC A09/MF A01 CSCL 12D

Utility theory provides the means for characterizing a decision maker's preferences over the range of some attribute. The ideas behind utility theory have been extended to decision making problems in which more than one attribute is used to characterize possible alternatives, and this extension is termed multi-attribute utility theory. A multi-attribute utility assessment computer program is developed which can handle consequences composed of two-attributes. It handles four particular cases of utility independence, utility independence in one direction, and no independence properties. A two-attribute consequence space was chosen particularly for the ability to represent the multi-attribute utility function graphically in three dimensions, from one of eight possible viewpoints. The utilities of two Air Force mission planners were assessed to determine the feasibility of using probability of arrival and probability of target destruction as factors for mission success. Based on the results, it appears as though multiattribute utility theory would be a definite help to Air Force mission planning. GRA

N88-18293# Utah Univ., Salt Lake City. Dept. of Computer Science.
COMPUTER AIDED GEOMETRIC DESIGN Final Report, Apr. 1982 - Mar. 1986
Richard F. Riesenfeld and Elaine Cohen 20 Sep. 1987 5 p
(Contract N00014-82-K-0351)
(AD-A187324) Avail: NTIS HC A02/MF A01 CSCL 12E

The purpose of this contract was to develop and apply subdivision techniques to Computer Aided Geometric Design, using the conceptual key based on the theory of discrete splines in the Oslo Algorithm computational engine. The basic validity of the theory and algorithms were established by the development of new modeling, graphical, and interactive schemes based on them and also the use of many of these ideas by other researchers and the use of the published results by industry. Related new theory and algorithms were developed; the mathematical model was extended. New styles of modeling were proposed and theory and algorithms for graphics and modeling of nonrectangular surface generalizations were developed. The role of graphics in design and modeling as a tool has been considered. GRA

N88-18294# Naval Postgraduate School, Monterey, Calif.
DERIVING ABSTRACTIONS FROM A SOFTWARE OBJECT NETWORK
Yih-Farn Chen and C. V. Ramamoorthy Aug. 1987 21 p
(AD-A187472; NPS52-87-037) Avail: NTIS HC A03/MF A01 CSCL 12E

High level abstractions from programs can be obtained by extracting relational information from programs to form a software object network, and deriving high level abstractions from that network. The authors show how to obtain several interesting abstractions such as subsystems, ripple effects, logical layers and modules from a software object network represented by a C program database. These abstractions assist programmers in understanding the program structure and point out potential areas for improvement. This document then demonstrates how rule-based software restructuring can be performed by accessing the relational information stored in the program database. GRA

N88-18295# Pittsburgh Univ., Pa. Learning Research and Development Center.
CHIPS: A TOOL FOR DEVELOPING SOFTWARE INTERFACES INTERACTIVELY
Robert E. Cunningham, John D. Corbett, and Jeffrey G. Bonar Oct. 1987 71 p
(Contracts N00014-83-K-0655; N00014-83-C-0148; Proj. RR0-4206)
(AD-A187499; UPITT/LRDC/ONR/LSP-4) Avail: NTIS HC A04/MF A01 CSCL 12E

Chips is an interactive tool for developing software employing graphical human/computer interfaces on Xerox Lisp machines. For the programmer, it provides a rich graphical interface. In the service of an end user, it provides classes for modeling the graphical relationships of objects on the screen and maintaining constraints between them. Several large applications have been developed with Chips including intelligent tutors for programming and electricity. Chips is implemented as a collection of customizable classes in the LOOPS object-oriented extensions to Interlisp-D. The three fundamental classes are: (1) DomainObject, which defines objects of the application domain, the domain for which the interface is being built , and ties together the various functionalities provided by the Chips system; (2) DisplayObject which defines mouse-sensitive graphical objects; and (3) Substrate which defines specialized windows for displaying and storing collections of instances of DisplayObject. A programmer creates an interface by specializing existing DomainObjects and drawing new DisplayObjects with a graphics editor. Instances of DisplayObject and Substrate are assembled on screen to form the interface. Once the interface has been sketched in this manner, the programmer can build inward, creating all other parts of the application through the objects on the screen. GRA

N88-18296# Air Force Inst. of Tech., Wright-Patterson AFB, Ohio. School of Systems and Logistics.
THE EFFECTS OF DATA STRUCTURE ON TOTAL TIME ON TEST PLOTS M.S. Thesis
Thomas J. Edwards Sep. 1987 60 p
(AD-A187628; AFIT/GLM/LSMB/87S-21) Avail: NTIS HC A04/MF A01 CSCL 12D

This research describes the effects data structure has on the Total Time on Test Transform technique and the resulting interpretation of the plot. Specifically, actual failure data on three card types (SUQ, BQQ, and BTJ) located in the Minuteman III Missile Guidance System was analyzed after manipulation. The manipulation consisted of the following three steps: (1) assign all zero time to failure values to the lowest failure time other than zero; (2) delete the zero time to failure values; and (3) delete all unusually high values from the sample data. After each step, the data was calculated and analyzed using Zenith 100 computer programs which performed the total time on test calculations and graphed those calculations into a total time on test data plot. The results of this analysis indicated that data structure does influence total time on test plots. The deletion of the zero time to failure values causes a movement upward of the data plot which could: (1) decrease the indication of decreasing failure rate (DFR), (2) increase or decrease the number of crossings on the 45 degree line, and (3) increase the indication of increasing failure rate (IFR). GRA

N88-18297# North Carolina Univ., Chapel Hill. Dept. of Computer Science.
SEMANTICS OF EqL
Bharat Jayaraman 1987 19 p
(Contract N00014-86-K-0680; Grant NSF DCR-86-03609)
(AD-A188151) Avail: NTIS HC A03/MF A01 CSCL 12E

This document presents the formal semantics of a novel language, called EqL, for first-order functional and Horn logic programming. An EqL program is a set of conditional pattern-directed rules, where the conditions are expressed as a conjunction of equations. The programming paradigm provided by this language may be called equational programming. The declarative semantics of equations is given in terms of their complete set of solutions, and the operational semantics for solving equations is an extension of reduction, called object refinement. The correctness of the operational semantics is established through soundness and completeness theorems. Examples are given to illustrate the language and its semantics. GRA

N88-18298# North Carolina Univ., Chapel Hill. Dept. of Computer Science.
A HYPERTEXT WRITING ENVIRONMENT AND ITS COGNITIVE BASIS
John B. Smith, Stephen F. Weiss, and Gordon J. Ferguson Oct. 1987 22 p
(Contract MDA903-86-C-0345)
(AD-A188179; TR-87-033) Avail: NTIS HC A03/MF A01 CSCL 05H

Writing Environment (WE) is a hypertext writing environment that can be used to create both electronic and printed documents. It is intended for professionals who work within a computer network of professional workstations. Since writing is a complex mental activity that uses many different kinds of thinking, WE was designed in accord with an explicit cognitive model for writing. That model raises several important questions for both electronic and printed documents. The paper includes a discussion of the underlying cognitive model, a description of WE as it currently exists and as it will be extended in the near future, as well as a brief outline of experiments being conducted to evaluate both model and system. It concludes by re-examining some of the issues raised by the cognitive model in light of WE, especially the role of constraints in hypertext systems. GRA

N88-18299*# National Aeronautics and Space Administration. Langley Research Center, Hampton, Va.
A VISUAL PROGRAMMING ENVIRONMENT FOR THE NAVIER-STOKES COMPUTER Final Report
Sherryl Tomboulian, Thomas W. Crockett, and David Middleton Jan. 1988 19 p Submitted for publication
(Contract NAS1-18107)
(NASA-CR-181615; ICASE-88-6; NAS 1.26:181615) Avail: NTIS HC A03/MF A01 CSCL 09B

The Navier-Stokes computer is a high-performance, reconfigurable, pipelined machine designed to solve large computational fluid dynamics problems. Due to the complexity of the architecture, development of effective, high-level language compilers for the system appears to be a very difficult task. Consequently, a visual programming methodology has been developed which allows users to program the system at an architectural level by constructing diagrams of the pipeline configuration. These schematic program representations can then be checked for validity and automatically translated into machine code. The visual environment is illustrated by using a prototype graphical editor to program an example problem. Author

N88-18300*# Syracuse Univ., N. Y. Dept. of Mechanical and Aerospace Engineering.
COMPREHENSIVE ANALYSIS OF HELICOPTERS WITH BEARINGLESS ROTORS Status Report
V. R. Murthy Mar. 1988 110 p
(Grant NAG1-759)
(NASA-CR-182537; NAS 1.26:182537) Avail: NTIS HC A06/MF A01 CSCL 09B

A modified Galerkin method is developed to analyze the dynamic problems of multiple-load-path bearingless rotor blades. The development and selection of functions are quite parallel to CAMRAD procedures, greatly facilitating the implementation of the method into the CAMRAD program. A software is developed implementing the modified Galerkin method to determine free vibration characteristics of multiple-load-path rotor blades undergoing coupled flapwise bending, chordwise bending, twisting, and extensional motions. Results are in the process of being obtained by debugging the software. Author

N88-18301*# National Aeronautics and Space Administration. Langley Research Center, Hampton, Va.
IMPLEMENTATION AND ANALYSIS OF A NAVIER-STOKES ALGORITHM ON PARALLEL COMPUTERS Final Report
Raad A. Fatoohi and Chester E. Grosch Jan. 1988 32 p Submitted for publication
(Contract NAS1-18107)
(NASA-CR-181614; ICASE-88-5; NAS 1.26:181614) Avail: NTIS HC A03/MF A01 CSCL 09B

The results of the implementation of a Navier-Stokes algorithm on three parallel/vector computers are presented. The object of this research is to determine how well, or poorly, a single numerical algorithm would map onto three different architectures. The algorithm is a compact difference scheme for the solution of the incompressible, two-dimensional, time-dependent Navier-Stokes equations. The computers were chosen so as to encompass a variety of architectures. They are the following: the MPP, an SIMD machine with 16K bit serial processors; Flex/32, an MIMD machine with 20 processors; and Cray/2. The implementation of the algorithm is discussed in relation to these architectures and measures of the performance on each machine are given. The basic comparison is among SIMD instruction parallelism on the MPP, MIMD process parallelism on the Flex/32, and vectorization of a serial code on the Cray/2. Simple performance models are used to describe the performance. These models highlight the bottlenecks and limiting factors for this algorithm on these architectures. Finally, conclusions are presented. Author

N88-18302*# National Aeronautics and Space Administration. Langley Research Center, Hampton, Va.
AN EFFICIENT SPARSE MATRIX MULTIPLICATION SCHEME FOR THE CYBER 205 COMPUTER
Jules J. Lambiotte, Jr. Mar. 1988 12 p
(NASA-TM-4028; L-16403; NAS 1.15:4028) Avail: NTIS HC A03/MF A01 CSCL 09B

This paper describes the development of an efficient algorithm for computing the product of a matrix and vector on a CYBER 205 vector computer. The desire to provide software which allows the user to choose between the often conflicting goals of minimizing central processing unit (CPU) time or storage requirements has led to a diagonal-based algorithm in which one of four types of storage is selected for each diagonal. The candidate storage types employed were chosen to be efficient on the CYBER 205 for diagonals which have nonzero structure which is dense, moderately sparse, very sparse and short, or very sparse and long; however, for many densities, no diagonal type is most efficient with respect to both resource requirements, and a trade-off must be made. For each diagonal, an initialization subroutine estimates the CPU time and storage required for each storage type based on results from previously performed numerical experimentation. These requirements are adjusted by weights provided by the user which reflect the relative importance the user places on the two resources. The adjusted resource requirements are then compared to select the most efficient storage and computational scheme. Author

N88-17852# Messerschmitt-Boelkow-Blohm G.m.b.H., Bremen (West Germany). Unternehmensgruppe Transport- und Verkehrsflugzeuge.
AN EXPERT SYSTEM TO SUPPORT THE VERIFICATION/VALIDATION OF FLIGHT-CRITICAL SOFTWARE [EIN EXPERTENSYSTEM ZUR UNTERSTUETZUNG DER VERIFIKATION/VALIDATION VON FLUGKRITISCHER SOFTWARE]
Norbert Heyder and Georgios Kastanakis *In its* Research and Development. Technical-Scientific Publications (1956-1987): Retrospective View and Prospects. Jubilee Edition on the Occasion of the 75th Anniversary of Dipl.-Engr. Dr.-Engr. E.H. Ludwig Boelkow 1987 p 209-212 In GERMAN (For primary document see N88-17819 10-31)
(MBB-UT-102/87) Copyright Avail: NTIS HC A14/MF A01

N88-18195# Supercomputing Research Center, Lanham, Md.
THE ARITHMETIC CUBE AND ITS ASSOCIATED ALGORITHMS
Mary Jane Irwin and Robert Michael Owens (Pennsylvania State Univ., University Park.) *In* North Carolina Univ., Proceedings of the Workshop on Future Directions in Computer Architecture and Software 30 Aug. 1986 p 38-47 (For primary document see N88-18191 10-60)
(Contract DAAG29-83-K-0126)
Avail: NTIS HC A18/MF A01 CSCL 09B

N88-18199# Army Stategic Defense Command, Huntsville, Ala.
SIGNAL AND DATA PROCESSING FOR IR SENSORS
D. E. Satterfield and R. C. Styles (Teledyne Brown Engineering, Huntsville, Ala.) *In* North Carolina Univ., Proceedings of the Workshop on Future Directions in Computer Architecture and Software 30 Aug. 1986 p 72-77 (For primary document see N88-18191 10-60)
Avail: NTIS HC A18/MF A01 CSCL 09B

N88-18200# Bell Telephone Labs., Inc., Holmdel, N. J.
ON PARALLELISM IN SOFTWARE/HARDWARE DESIGN TOOLS
P. A. Subrahmanyam *In* North Carolina Univ., Proceedings of the Workshop on Future Directions in Computer Architecture and Software 30 Aug. 1986 p 78-84 (For primary document see N88-18191 10-60)
Avail: NTIS HC A18/MF A01 CSCL 09B

N88-18205# Concordia Univ., Montreal (Quebec). Dept. of Computer Science.
IMPLEMENTATION OF A BUDDY FAILURE RECOVERY CONCEPT IN THE NOVAC SYSTEM
B. C. Desai *In* North Carolina Univ., Proceedings of the Workshop

on Future Directions in Computer Architecture and Software 30 Aug. 1986 p 114-121 (For primary document see N88-18191 10-60)
Avail: NTIS HC A18/MF A01 CSCL 09B

N88-18208# Colorado State Univ., Fort Collins. Dept. of Computer Science.
SISAL: INITIAL MIMD PERFORMANCE RESULTS
R. R. Oldehoeft, D. C. Cann, and S. J. Allan *In* North Carolina Univ., Proceedings of the Workshop on Future Directions in Computer Architecture and Software 30 Aug. 1986 p 139-145 (For primary document see N88-18191 10-60)
Avail: NTIS HC A18/MF A01 CSCL 09B

N88-18209# Purdue Univ., West Lafayette, Ind. Dept. of Computer Sciences.
THE MAPPING OF PARALLEL ALGORITHMS TO RECONFIGURABLE PARALLEL ARCHITECTURES
Leah H. Jamieson, Howard Jay Siegel, Edward J. Delp, and Andrew Whinston *In* North Carolina Univ., Proceedings of the Workshop on Future Directions in Computer Architecture and Software 30 Aug. 1986 p 147-154 (For primary document see N88-18191 10-60)
(Contracts F30602-83-K-0119; N00014-85-C-2182; MDA904-85-5027; Grant F49620-86-K-0005)
Avail: NTIS HC A18/MF A01 CSCL 09B

N88-18212# Stanford Univ., Calif. Dept. of Electrical Engineering.
WHY REUSABLE SOFTWARE ISN'T
William J. Tracz *In* North Carolina Univ., Proceedings of the Workshop on Future Directions in Computer Architecture and Software 30 Aug. 1986 p 171-177 Prepared in cooperation with IBM Federal Systems Div., Owego, N.Y. (For primary document see N88-18191 10-60)
Avail: NTIS HC A18/MF A01 CSCL 09B

N88-18213# Illinois Univ., Urbana-Champaign. Dept. of Computer Science.
TOWARDS REUSABLE SOFTWARE DESIGNS AND IMPLEMENTATIONS
Ralph E. Johnson and Simon M. Kaplan *In* North Carolina Univ., Proceedings of the Workshop on Future Directions in Computer Architecture and Software 30 Aug. 1986 p 178-185 (For primary document see N88-18191 10-60)
Avail: NTIS HC A18/MF A01 CSCL 09B

N88-18214# General Dynamics Corp., San Diego, Calif. Div. of General Dynamics Data Systems.
ARCHETYPING: A KNOWLEDGE-BASED REUSE PARADIGM
Stanley M. Przybylinski *In* North Carolina Univ., Proceedings of the Workshop on Future Directions in Computer Architecture and Software 30 Aug. 1986 p 186-193 (For primary document see N88-18191 10-60)
Avail: NTIS HC A18/MF A01 CSCL 09B

N88-18224# Carnegie-Mellon Univ., Pittsburgh, Pa. Software Engineering Inst.
SOFTWARE SUPPORT FOR HETEROGENEOUS MACHINES
Mario R. Barbacci *In* North Carolina Univ., Proceedings of the Workshop on Future Directions in Computer Architecture and Software 30 Aug. 1986 p 261-268 (For primary document see N88-18191 10-60)
Avail: NTIS HC A18/MF A01 CSCL 09B

N88-18234# Bradley Univ., Peoria, Ill. Dept. of Computer Science.
DEVELOPING A STANDARD TAXONOMY OR SOFTWARE ENGINEERING STANDARDS
John Fendrich *In* North Carolina Univ., Proceedings of the Workshop on Future Directions in Computer Architecture and Software 30 Aug. 1986 p 299-300 (For primary document see N88-18191 10-60)
Avail: NTIS HC A18/MF A01 CSCL 09B

N88-18236# Old Dominion Univ., Norfolk, Va. Dept. of Electrical Engineering.
STRATEGIES FOR CONCURRENT PROCESSING OF COMPLEX ALGORITHMS
John W. Stoughton and Roland R. Mielke *In* North Carolina Univ., Proceedings of the Workshop on Future Directions in Computer Architecture and Software 30 Aug. 1986 p 304-306 (For primary document see N88-18191 10-60)
Avail: NTIS HC A18/MF A01 CSCL 09B

N88-18237# Ecole Normale Superieure, Saint Cloud (France).
PORTABLE (AND DISPOSABLE) INTERPRETERS
Francois-Xavier Testard-Vaillant *In* North Carolina Univ., Proceedings of the Workshop on Future Directions in Computer Architecture and Software 30 Aug. 1986 p 307-314 Prepared in cooperation with Laboratoire d'Informatique Theorique et Programmation, Paris (France) (For primary document see N88-18191 10-60)
Avail: NTIS HC A18/MF A01 CSCL 09B

N88-18238# South Carolina Univ., Columbia. Dept. of Electrical and Computer Engineering.
A RULE-BASED LISP DIALECT TRANSLATOR USING PARAMODULATION
Michael Dowell and Yoshiyasu Takefuji *In* North Carolina Univ., Proceedings of the Workshop on Future Directions in Computer Architecture and Software 30 Aug. 1986 p 316-318 (For primary document see N88-18191 10-60)
Avail: NTIS HC A18/MF A01 CSCL 09B

N88-18239# Bolt, Beranek, and Newman, Inc., Cambridge, Mass.
SEMI-APPLICATIVE PROGRAMMING
N. S. Sridharan *In* North Carolina Univ., Proceedings of the Workshop on Future Directions in Computer Architecture and Software 30 Aug. 1986 p 319-322 (For primary document see N88-18191 10-60)
(Contract N00014-85-C-0079)
Avail: NTIS HC A18/MF A01 CSCL 09B

N88-18240# Temple Univ., Philadelphia, Pa.
EXPERIMENTING WITH PARALLEL PROGRAMING IN LOGIC
Abraham Wakeman *In* North Carolina Univ., Proceedings of the Workshop on Future Directions in Computer Architecture and Software 30 Aug. 1986 p 323-325 (For primary document see N88-18191 10-60)
Avail: NTIS HC A18/MF A01 CSCL 09B

N88-18244# North Carolina State Univ., Raleigh. Dept. of Computer Science.
PROGRAMMING LANGUAGE TRANSLATION FOR MULTICOMPUTERS
Jon Mauney *In* North Carolina Univ., Proceedings of the Workshop on Future Directions in Computer Architecture and Software 30 Aug. 1986 p 334-335 (For primary document see N88-18191 10-60)
Avail: NTIS HC A18/MF A01 CSCL 09B

N88-18245# Illinois Univ., Urbana-Champaign. Dept. of Computer Science.
RESILIENT PROCEDURES: A STRUCTURED REPLICATION APPROACH
Kwei-Jay Lin and Mark E. Wittle *In* North Carolina Univ., Proceedings of the Workshop on Future Directions in Computer Architecture and Software 30 Aug. 1986 p 336-338 Sponsored in part by Illinois Univ., Urbana (For primary document see N88-18191 10-60)
Avail: NTIS HC A18/MF A01 CSCL 09B

N88-18247# Rensselaer Polytechnic Inst., Troy, N.Y. Center for Integrated Electronics.
WAFER SCALE IMPLEMENTATION OF A GaAs SYSTOLIC SIGNAL PROCESSOR CELL
H. Merchant, H. Greub, R. Schreiber, B. Donlan, and J. F.

McDonald *In* North Carolina Univ., Proceedings of the Workshop on Future Directions in Computer Architecture and Software 30 Aug. 1986 p 343-345 (For primary document see N88-18191 10-60)
Avail: NTIS HC A18/MF A01 CSCL 09B

N88-18251# Indiana Univ., Bloomington. Dept. of Computer Science.
AN APPLICATIVE PROGRAMMER'S APPROACH TO MATRIX ALGEBRA, LESSONS FOR HARDWARE AND SOFTWARE
David S. Wise *In* North Carolina Univ., Proceedings of the Workshop on Future Directions in Computer Architecture and Software 30 Aug. 1986 p 357-359 (For primary document see N88-18191 10-60)
(Grant NSF DCR-84-05241)
Avail: NTIS HC A18/MF A01 CSCL 09B

N88-18252# Utah Univ., Salt Lake City. Dept. of Computer Science.
IMPLEMENTING LOGICAL VARIABLES ON A GRAPH REDUCTION ARCHITECTURE
Gary Linstrom *In* North Carolina Univ., Proceedings of the Workshop on Future Directions in Computer Architecture and Software 30 Aug. 1986 p 361-363 Sponsored in part by Shared Univ. Research Grant from IBM Corp. (For primary document see N88-18191 10-60)
(Grant NSF DCR-85-06000)
Avail: NTIS HC A18/MF A01 CSCL 09B

62 COMPUTER SYSTEMS

Includes computer networks and special application computer systems.

N88-18303# Naval Research Lab., Washington, D.C.
A FRAMEWORK FOR EVALUATING COMPUTER ARCHITECTURES TO SUPPORT SYSTEMS WITH SECURITY REQUIREMENTS, WITH APPLICATIONS Final Report, 1984 - 1987
Carl E. Landwehr, Brian Tretick, John M. Carroll, and Paul Anderson 5 Nov. 1987 57 p
(AD-A187082; NRL-9088) Avail: NTIS HC A04/MF A01 CSCL 09B

This report develops a set of criteria for evaluating computer architectures that are to support systems with security requirements. Central to these criteria is the concept of a domain, here interpreted as a set of information and authorizations for the manipulation of that information in a computer system. Architectural requirements are grouped in three categories: logical structure, the processing of logical structures, and physical structure. Appendixes describe the Navy's AN/UYK-43 and AN/UYK-44, DEC VAX 11/780m IBM 370-XA, Intel 80286, and Honeywell SCOMP architectures within this framework. These descriptions are intended to inform readers about the characteristics of these particular architectures and to provide readers with examples so that they many evaluate other systems relevant to their particular needs. GRA

N88-18304# Illinois Univ., Urbana. Center for Supercomputing Research and Development.
AN ETHERNET LOCAL AREA NETWORK CONTROLLER WITH SUPPORTING OPERATING SYSTEM SOFTWARE M.S. Thesis
Kris Gibson Konigsfeld Aug. 1987 93 p Sponsored in part by IBM Corp., Apollo Computer, Inc.
(Contract DE-FG02-85ER-25001; Grant NSF DCR-84-10110)
(DE88-003534; DOE/ER-25001/92; CSRD-668; UILU-ENG-87-8004) Avail: NTIS HC A05/MF A01

Presented in this thesis is the design of an Ethernet local area network as applied to both a general purpose interface and an application specific network system. First, the design considerations for both hardware and software are analyzed. Next, the design of an IBM PC/AT Ethernet controller and interface is presented. The hardware is described as it relates specifically to the IBM PC/AT environment as well as a development system for a stand-alone processor and communication link. One application of this stand-alone processor is the Cedar diagnostic system which uses several remote processors linked together through an Ethernet network. In addition to being a development system, the IBM PC/AT controller is also a potential network manager for the diagnostic system. The design of the controller's low-level operating system is also described as an implementation of the issues of protocol control and processor management. The operating system executes within the confines of the stand-alone processor system and may also be applied to the Cedar diagnostic system as a flexible program executive. Finally, current development problems and future work are presented. DOE

N88-18305# Illinois Univ., Urbana. Center for Supercomputing Research and Development.
THE LAMBDA NETWORK: A NEW PERMUTATION NETWORK
D. Lee 1987 5 p Presented at the International Conference on Parallel Processing, St. Charles, Ill., 17 Aug. 1987 Submitted for publication. Sponsored in part by IBM Corp.
(Contract DE-FG02-85ER-25001; Grants NSF DCR-84-10110; NSF DCR-85-09970; AF AFOSR-85-0211)
(DE88-003568; DOE/ER-25001/61; CONF-870831-10) Avail: NTIS HC A02

A new permutation network, called the Lambda network is presented. The Lambda network, which is based on the Batcher sorter, passes arbitrary permutation under a local single bit control. The network is highly modular, and suitable for a pipelined, packet-switching operation. This construction of the network illustrates an approach by which a permutation network can be obtained from a sorting network. Also the basic idea of deriving a new multistage interconnection network from a permutation network is discussed, together with some aspects of the applications of the Lambda network as an interconnection network for a parallel supercomputer. DOE

N88-18306# Illinois Univ., Urbana. Center for Supercomputing Research and Development.
PARALLEL ACCESS TO SYNCHRONIZATION VARIABLES
D. N. Jayasimha Jan. 1987 11 p Presented at the International Conference on Parallel Processing, St. Charles, Ill., 17 Aug. 1987
(Contract DE-FG02-85ER-25001)
(DE88-003570; DOE/ER-25001/63; CONF-870831-8) Avail: NTIS HC A03/MF A01

The following synchronization problem occurs in parallel processing: a set of n processes need to begin execution of their next tasks only after every process has completed its current task. Such a barrier synchronization is usually implemented by shared variable(s) in a tightly coupled multiprocessor. The completion time is defined as the earliest time when every process knows that all other processes are completed. Analytical models are developed using Markov chains to estimate the effects of barrier synchronization on the completion time of processes. Three algorithms are given to implement barrier synchronization and completion time expressions are derived for these implementations. The relative merits of the three schemes are compared. Two schemes require O(nlogn) accesses as opposed to 2n-1, the idealized number of accesses. The third scheme which is difficult to implement has a linear growth in the number of accesses (approx. 4n). DOE

N88-18307# Illinois Univ., Urbana.
LOOP COALESCING: A COMPILER TRANSFORMATION FOR PARALLEL MACHINES
C. D. Polychronopoulos 1987 8 p Presented at the International Conference on Parallel Processing, St. Charles, Ill., 17 Aug. 1987
(Contract DE-FG02-85ER-25001)
(DE88-003571; DOE/ER-25001/64; CONF-870831-7) Avail: NTIS HC A02

A compiler transformation is discussed called loop coalescing which can be used to reduce run-time overhead and simplify the loop scheduling problem. Parallel loops account for the greatest

amount of parallelism in numerical programs. Executing nested loops in parallel with low run-time overhead is thus very important for achieving high performance on parallel computers. Loop coalescing is a restructuring technique that transforms several types of nested parallel loops into a single loop. As a result of this transformation the loop scheduling problem becomes simple. Moreover the amount of synchronization (i.e., run-time overhead) associated with the parallel execution of loops is reduced sharply through loop coalescing. Several examples are presented and the general transformation is discussed in detail. Also given is an example of the application of loop coalescing to loop scheduling. DOE

N88-18308# Illinois Univ., Urbana. Center for Supercomputing Research and Development.

THE PERFORMANCE OF SOFTWARE-MANAGED MULTIPROCESSOR CACHES ON PARALLEL NUMERICAL PROGRAMS

Hoichi Cheong and A. V. Veidenbaum 1987 22 p Presented at the International Conference on Supercomputing, Athens, Greece, 8 Jun. 1987

(Contract DE-FG02-85ER-25001)

(DE88-003590; DOE/ER-25001/36; CONF-8706183-3) Avail: NTIS HC A03

In recent years interest has grown in multiprocessor architectures that can have several hundred processors sharing memory and all working on solving a single problem. Such multiprocessors are characterized by a long memory access time, which makes use of cache memories very important. However, the cache coherence problem makes the use of private caches difficult. The proposed solutions to the cache coherence problem are not suitable for a large-scale multiprocessor. We proposed a different solution that relies on a compiler to manage the caches during the execution of a parallel program. In this paper we discuss the performance evaluation of private cache memories for multiprocessors in general and present the results of performance improvement for parallel numerical programs using the caches managed with compiler assistance. The effect of cache organization and other system parameters such as cache block size, cache size, and the number of processors in the system performance is shown. DOE

N88-18309# Illinois Univ., Urbana. Center for Supercomputing Research and Development.

A PARALLEL QUASI-NEWTON METHOD FOR PARTIALLY SEPARABLE LARGE SCALE MINIMIZATION

M. Q. Chen and S. P. Han Apr. 1987 28 p Prepared in cooperation with Illinois Univ., Urbana.

(Contract DE-FG02-85ER-25001)

(DE88-003592; DOE/ER-25001/51) Avail: NTIS HC A03/MF A01

The parallel quasi-Newton method based on updating conjugate subspaces can be very effective for large-scale sparse minimization because conjugate subspaces with respect to sparse Hessians are usually easy to obtain. This point is demonstrated for the partially separable case with matrices updated by a quasi-Newton scheme of Griewank and Toint. The algorithm presented is suitable for parallel computation and economical in computer storage. Some testing results of the algorithm on an Alliant FX/8 minisupercomputer are reported. DOE

N88-18310# Technische Hogeschool, Delft (Netherlands). Afd. der Elektrotechniek.

PERFORMANCE STUDIES OF A PARALLEL PROCESSOR FOR LARGE LINEAR PROGRAMMING PROBLEMS M.S. Thesis

Jian Luo Dec. 1986 109 p

(PB88-121611) Avail: NTIS HC A06/MF A01 CSCL 09B

To speed up the solution of large linear programming (LP) problems a new parallel processor is developed. For this processor a parallel algorithm is established and investigated. Several pivot searching strategies are described and compared using some LP models which have been made for simulation purposes. It appears that using k processors, the speed for solving an LP can be about k times faster (when there is no bus-congestion). It also appears that a little effort in the pivot searching phase can reduce the total number of iterations for solving an LP model and thus the total computing time. GRA

N88-18311# Wichita State Univ., Kans. Dept. of Computer Science.

DYNAMIC PROCESSOR SELF-SCHEDULING FOR GENERAL PARALLEL NESTED LOOPS

Zhixi Fang, Peiyi Tang, Pen-Chung Yew, and Chuan-Qi Zhu 10 Sep. 1987 42 p Presented at the International Conference on Parallel Processing, St. Charles, Ill., 17 Aug. 1987 Prepared in cooperation with Illinois Univ., Urbana

(Contract DE-FG02-85ER-25001)

(DE88-003572; DOE/ER-25001/65; CONF-870831-14) Avail: NTIS HC A03/MF A01

In this paper we present a completely dynamic processor self-scheduling approach for general nested loops. General nested loops contain both parallel and serial loops and the execution time of their iterations can vary widely. In our scheme, an instance of an innermost loop is considered to be a basic unit in a precedence graph. An instance is said to be active if the instance is ready to be executed. Completion of an instance will activate instance of other innermost loops. The basic concept in our scheme is to keep all processors busy as long as there exists any active instance. By effectively using synchronization primitive provided in a parallel processing system, the overhead of our approach can be significantly reduced. We also present the data structure needed to represent a general nested loop in our self-scheduling scheme. DOE

N88-18312*# Illinois Univ., Urbana. Dept. of Computer Science.

PARALLEL DISCRETE EVENT SIMULATION: A SHARED MEMORY APPROACH

D. A. Reed, A. D. Malony, and B. D. McCredie 1987 32 p Presented at the ACM Sigmetrics Conference on Measurement and Modeling of Computer Systems, Banff, Alberta, 1 May 1987

(Grant NAG1-163)

(NASA-CR-182521; NAS 1.26:182521; DE88-003582; DOE/ER-25001/70; CONF-8705243-1) Avail: NTIS HC A03/MF A01 CSCL 09B

Distributed simulation has been the subject of several simulated performance studies; little or no experimental data have heretofore been available. Obtaining such data was the primary goal of this work. Using queueing networks as the simulation application, we simulated a variety of such networks with varying workloads using several variations of the Chandy-Misra algorithm on a shared memory machine. These experiments show that, with rare exception, the Chandy-Misra approach to distributed simulation is not a viable approach to parallel simulation of queueing network models. There are two primary reasons for this. First, a single processor implementation of the Chandy-Misra algorithm is sometimes slower than the equivalent sequential, event-driven simulation. Thus, multiple processors are needed just to recoup the loss due to the inefficiency. Second, networks with cycles require deadlock avoidance or recovery techniques. These techniques are extremely costly, and there is little prospect that they can be reduced to acceptable levels. DOE

N88-18313# Illinois Univ., Urbana. Center for Supercomputing Research and Development.

DEADLOCK PREVENTION IN PROCESSOR SELF-SCHEDULING FOR PARALLEL NESTED LOOPS

Peiyi Tang, Pen-Chung Yew, Zhixi Fang, and Chuan-Qi Zhu Jan. 1987 39 p Presented at the International Conference on Parallel Processing, St. Charles, Ill., 17 Aug. 1987 Prepared in cooperation with Wichita State Univ., Kans.

(Contract DE-FG02-85ER-25001)

(DE88-003573; DOE/ER-25001/39; CONF-870831-5; CSRD-626) Avail: NTIS HC A03/MF A01

Processor self-scheduling is an effective distributed dynamic scheduling scheme for parallel nested loops in multiprocessor

systems. A parallel nested loop structure can be considered as a task system. A task is an interation (or several iterations) of an innermost loop body. The execution order of tasks is determined by a precedence relation. Data dependences among statements are enforced either by the precedence relation or by explicit synchronization. Since self-scheduling is non-preemptive and uses busy-waiting as the basic technique for task synchronization, deadlocks may possibly arise. This paper identifies conditions that allow deadlock-free processor self-scheduling. It uses control tokens and data tokens to model the precedence relation and data dependences. Both control tokens and data tokens, together with processors, are regarded as three kinds of resources needed by tasks. Based on this resource model, we study three possible self-scheduling schemes with different degrees of parallelism, and propose to use appropriate scheduling priority for allocating processors to prevent deadlocks. DOE

N88-18314# Illinois Univ., Urbana. Center for Supercomputing Research and Development.
DATA PREFETCHING IN SHARED MEMORY MULTIPROCESSORS
R. L. Lee, Pen-Chung Yew, and D. H. Lawrie 1987 5 p Presented at the International Conference on Parallel Processing, St. Charles, Ill., 17 Aug. 1987
(Contract DE-FG02-85ER-25001)
(DE88-003576; DOE/ER-25001/41; CONF-870831-15) Avail: NTIS HC A02

The trace driven simulation of 16 numerical subroutines is used to compare instruction lookahead and data prefetching with private caches in shared memory multiprocessors with hundreds or thousands of processors and memory modules interconnected with a pipelined network. These multiprocessors are characterized by long memory access delays that create a memory access bottleneck. Using the multiprocessor cache model for comparison, data prefetching is found to be more effective than caches in addressing the memory access bottleneck. DOE

N88-18315# North Carolina Univ., Chapel Hill. Dept. of Computer Science.
SHARED WORKSPACES FOR REAL-TIME COLLABORATION IN DISTRIBUTED NETWORKS: CONCEPTS, TECHNIQUES, PROBLEMS
Hussein M. AbdelWahab, Sheng-Uei Guan, and J. Nievergelt 1987 22 p
(Contract N00014-86-K-0680)
(AD-A188150) Avail: NTIS HC A03/MF A01 CSCL 25E

Until recently, computer-based collaboration between geographically dispersed users has been limited primarily to electronic mail and file transfer. There is an increasing interest in computer support for real-time interaction between such users. The main goal of this research is to enable users to remotely share and operate simultaneously on objects contained in a workspace. Examples of objects are textfiles, graphs, or images. All participants have identical views of the objects. Users manipulate and operate on the objects using appropriate tools. For example, an appropriate tool for operating on a textfile is a text editor. The basic entities of our model: users, objects and tools, may reside at arbitrary sites of a computer network. Users who wish to collaborate and share a workspace will form a session. For each session, a process called the session server regulates access to workspace objects efficiently and fairly. All session servers of a given machine are interfaced to a process called the communications server. The communications server is responsible for connecting users and moving objects between different machines. GRA

N88-18201# Bell Telephone Labs., Inc., Holmdel, N. J. Computer and Robotics Research Lab.
ROLE OF BROADCASTING IN MULTIPROCESSOR SYSTEMS
Binay Sugla and Sudhir Ahuja *In* North Carolina Univ., Proceedings of the Workshop on Future Directions in Computer Architecture and Software 30 Aug. 1986 p 86-89 (For primary document see N88-18191 10-60)
Avail: NTIS HC A18/MF A01 CSCL 09B

N88-18202# Texas Instruments, Inc., Dallas.
IMAGE TEXTURE CLASSIFICATION WITH AN OPTICAL CROSSBAR INTERCONNECTED PROCESSOR
Alastair D. McAulay *In* North Carolina Univ., Proceedings of the Workshop on Future Directions in Computer Architecture and Software 30 Aug. 1986 p 90-97 (For primary document see N88-18191 10-60)
(Contract N00014-85-C-0755)
Avail: NTIS HC A18/MF A01 CSCL 09B

N88-18210# Illinois Univ., Urbana. Dept. of Computer Science.
A DISTRIBUTED SYSTEM ARCHITECTURE BASED ON MACRO DATAFLOW MODEL
Jane W. S. Liu and Andrew Grimshaw *In* North Carolina Univ., Proceedings of the Workshop on Future Directions in Computer Architecture and Software 30 Aug. 1986 p 155-162 (For primary document see N88-18191 10-60)
(Grant NAG1-613)
Avail: NTIS HC A18/MF A01 CSCL 09B

N88-18211# Missouri Univ., Columbia. Dept. of Computer Sciences.
A COMPARATIVE STUDY OF HEURSTIC ALGORITHMS FOR TASK ASSIGNMENT IN DISTRIBUTED COMPUTING SYSTEMS
Kamal Efe *In* North Carolina Univ., Proceedings of the Workshop on Future Directions in Computer Architecture and Software 30 Aug. 1986 p 163-169 (For primary document see N88-18191 10-60)
Avail: NTIS HC A18/MF A01 CSCL 09B

N88-18215# State Univ. of New York, Stony Brook. Dept. of Computer Science.
DISTRIBUTED CONTROL OF LARGE PARALLEL COMPUTERS
Larry D. Wittie *In* North Carolina Univ., Proceedings of the Workshop on Future Directions in Computer Architecture and Software 30 Aug. 1986 p 195-201 (For primary document see N88-18191 10-60)
Avail: NTIS HC A18/MF A01 CSCL 09B

N88-18216# Princeton Univ., N. J. Dept. of Computer Science.
THE DESIGN OF LOAD BALANCING STRATEGIES FOR DISTRIBUTED SYSTEMS
Rafael Alonso *In* North Carolina Univ., Proceedings of the Workshop on Future Directions in Computer Architecture and Software 30 Aug. 1986 p 202-207 (For primary document see N88-18191 10-60)
Avail: NTIS HC A18/MF A01 CSCL 09B

N88-18217# Rice Univ., Houston, Tex. Dept. of Computer Science.
EXPERIMENTS WITH PARALLEL PROGRAM EXECUTION ON A NETWORK OF WORKSTATIONS
Willy Zwaenepoel *In* North Carolina Univ., Proceedings of the Workshop on Future Directions in Computer Architecture and Software 30 Aug. 1986 p 208-212 Sponsored in part by IBM Faculty Development Award (For primary document see N88-18191 10-60)
(Grant NSF DCR-85-11436)
Avail: NTIS HC A18/MF A01 CSCL 09B

N88-18219# Illinois Univ., Chicago. Dept. of Electrical Engineering and Computer Science.
DISTRIBUTED QUERY PROCESSING: PRESENT STATUS AND FUTURE DIRECTION
C. T. Yu and K. C. Guh *In* North Carolina Univ., Proceedings of the Workshop on Future Directions in Computer Architecture and Software 30 Aug. 1986 p 220-227 (For primary document see N88-18191 10-60)
Avail: NTIS HC A18/MF A01 CSCL 09B

N88-18220# Pennsylvania State Univ., University Park. Dept. of Electrical Engineering.
A PARADIGM FOR CONCURRENCY CONTROL PERFORMANCE EVALUATION
A. A. Helal, A. K. Elmogarmid, and A. R. Hurson *In* North Carolina Univ., Proceedings of the Workshop on Future Directions in Computer Architecture and Software 30 Aug. 1986 p 228-235 (For primary document see N88-18191 10-60)
Avail: NTIS HC A18/MF A01 CSCL 09B

N88-18222# Rensselaer Polytechnic Inst., Troy, N.Y. Dept. of Computer Science.
PREDICATE ANALYSIS FOR PARALLEL PROGRAM GENERATION
Boleslaw K. Szymanski *In* North Carolina Univ., Proceedings of the Workshop on Future Directions in Computer Architecture and Software 30 Aug. 1986 p 245-252 (For primary document see N88-18191 10-60)
Avail: NTIS HC A18/MF A01 CSCL 09B

N88-18223# Martin Marietta Aerospace, Denver, Colo.
AN INVESTIGATION OF PARALLELISM IN RULE BASED SYSTEMS
Steven D. Raney and David A. Marshall *In* North Carolina Univ., Proceedings of the Workshop on Future Directions in Computer Architecture and Software 30 Aug. 1986 p 253-260 (For primary document see N88-18191 10-60)
Avail: NTIS HC A18/MF A01 CSCL 09B

N88-18225# North Carolina State Univ., Raleigh. Dept. of Electrical and Computer Engineering.
THE CASE FOR A SHARED ADDRESS SPACE
Edward F. Gehringer *In* North Carolina Univ., Proceedings of the Workshop on Future Directions in Computer Architecture and Software 30 Aug. 1986 p 270-272 (For primary document see N88-18191 10-60)
(Contract MDA904-86-14-0003)
Avail: NTIS HC A18/MF A01 CSCL 09B

N88-18227# Rensselaer Polytechnic Inst., Troy, N.Y. Dept. of Computer Science and Center for Integrated Electronics.
A PARALLEL COMPUTER BASED ON CUBE CONNECTED CYCLES
M. J. Chung, E. J. Toy, and A. A. Lobo *In* North Carolina Univ., Proceedings of the Workshop on Future Directions in Computer Architecture and Software 30 Aug. 1986 p 276-278 (For primary document see N88-18191 10-60)
Avail: NTIS HC A18/MF A01 CSCL 09B

N88-18228# North Carolina State Univ., Raleigh. Dept. of Electrical and Computer Engineering.
AN ANLYSIS OF THE RELIABILITY OF TREE-STRUCTURED INTERCONNECTION NETWORKS
Ravi Mehrotra and Edward F. Gehringer *In* North Carolina Univ., Proceedings of the Workshop on Future Directions in Computer Architecture and Software 30 Aug. 1986 p 279-283 (For primary document see N88-18191 10-60)
Avail: NTIS HC A18/MF A01 CSCL 09B

N88-18229# Clemson Univ., S.C. Dept. of Computer Science.
PERFORMANCE EVALUATION OF A LOOP INTERCONNECTION STRUCTURE
Edward W. Page *In* North Carolina Univ., Proceedings of the Workshop on Future Directions in Computer Architecture and Software 30 Aug. 1986 p 284-286 (For primary document see N88-18191 10-60)
Avail: NTIS HC A18/MF A01 CSCL 09B

N88-18230# Michigan Univ., Ann Arbor. Dept. of Electrical Engineering and Computer Science.
ON THE NUMBER OF TASK ASSIGNMENTS IN DISTRIBUTED COMPUTING SYSTEMS
Kang G. Shin *In* North Carolina Univ., Proceedings of the Workshop on Future Directions in Computer Architecture and Software 30 Aug. 1986 p 287-288 (For primary document see N88-18191 10-60)
(Contract N00014-85-K-0122)
Avail: NTIS HC A18/MF A01 CSCL 09B

N88-18231# Michigan State Univ., East Lansing. Dept. of Computer Science.
REUSE: A RELIABLE UNIFIED SERVICE ENVIRONMENT FOR DISTRIBUTED SYSTEMS
Lionel M. Ni and Thomas B. Gendreau *In* North Carolina Univ., Proceedings of the Workshop on Future Directions in Computer Architecture and Software 30 Aug. 1986 p 290-292 (For primary document see N88-18191 10-60)
Avail: NTIS HC A18/MF A01 CSCL 09B

N88-18232# Monash Univ., Clayton (Australia).
ASPECTS OF A MULTIPROCESSOR ARCHITECTURE
R. Pose, M. S. Anderson, and C. S. Wallace *In* North Carolina Univ., Proceedings of the Workshop on Future Directions in Computer Architecture and Software 30 Aug. 1986 p 293-295 (For primary document see N88-18191 10-60)
Avail: NTIS HC A18/MF A01 CSCL 09B

N88-18241# Texas Univ., Austin. Dept. of Computer Science.
PARALLEL ARCHITECTURES FOR LOGIC PROGRAMMING
Vipin Kumer and Yow-Jian Lin *In* North Carolina Univ., Proceedings of the Workshop on Future Directions in Computer Architecture and Software 30 Aug. 1986 p 326-327 (For primary document see N88-18191 10-60)
(Grant DAAG29-84-K-0060)
Avail: NTIS HC A18/MF A01 CSCL 09B

N88-18253# Washington State Univ., Pullman. Dept. of Electrical and Computer Engineering.
MULTI-PROCESSOR REDUCTION MACHINES
J. L. Meador and M. L. Manwaring *In* North Carolina Univ., Proceedings of the Workshop on Future Directions in Computer Architecture and Software 30 Aug. 1986 p 364-366 (For primary document see N88-18191 10-60)
Avail: NTIS HC A18/MF A01 CSCL 09B

N88-18254# Massachusetts Inst. of Tech., Cambridge. Dept. of EECS.
MASSIVE FINE-GRAIN PARALLELISM IN ARRAY COMPUTATION: A DATA FLOW SOLUTION
Guang R. Gao *In* North Carolina Univ., Proceedings of the Workshop on Future Directions in Computer Architecture and Software 30 Aug. 1986 p 367-369 (For primary document see N88-18191 10-60)
Avail: NTIS HC A18/MF A01 CSCL 09B

63 CYBERNETICS

Includes feedback and control theory, artificial intelligence, robotics and expert systems.

For related information see also *54 Man/System Technology and Life Support.*

N88-18316# Texas Univ., Houston. Medical School.
ANALYSIS AND SYNTHESIS OF ADAPTIVE NEURAL ELEMENTS Final Report, 1 Aug. 1984 - 31 Jul. 1987
John H. Byrne 30 Sep. 1987 11 p
(Grant AF-AFOSR-0213-84)
(AD-A187047; AFOSR-87-1567TR) Avail: NTIS HC A03/MF A01 CSCL 09B

The overall goal of this research is to provide insights into the adaptive capabilities of individual neurons, which will lead to the development of machines having some of the information processing capabilities of the nervous system. During the period between 01 August 1984 and 31 July 1987, significant progress has been in three major directions. First, experimental studies on the modulation of ionic conductance mechanisms have been performed on individual neurons believed to contribute to neuronal

plasticity and classical conditioning of defensive reflexes. Second, we have begun to identify elements of the neuronal circuit that contributes to operant conditioning of feeding behavior. Third, a single cell neuronal model for classical conditioning has been developed and simulated on a digital computer. GRA

N88-18317# Illinois Univ., Urbana. Center for Supercomputing Research and Development.
PARALLEL GARBAGE COLLECTION ON A VIRTUAL MEMORY SYSTEM
S. G. Abraham and J. H. Patel 1987 26 p Presented at the 14th Annual International Symposium on Computer Architecture, Pittsburgh, Pa., 2 Jun. 1987
(Contract DE-FG02-85ER-25001)
(DE88-003567; DOE/ER-25001/60; CONF-8706138-2) Avail: NTIS HC A03/MF A01

Since most artificial intelligence applications are programmed in list processing languages, it is important to design architectures to support efficient garbage collection. This paper presents an architecture and an associated algorithm for parallel garbage collection on a virtual memory system. All the previously proposed parallel algorithms attempt to collect cells released by the list processor during the garbage collection cycle. We do not attempt to collect such cells. As a consequence, the list processor incurs little overhead in the proposed scheme, since it need not synchronize with the collector. Most parallel algorithms are designed for shared memory machines which have certain implicit synchronization functions on variable access. The proposed algorithm is designed for virtual memory systems where both the list processor and the garbage collector have private memories. The enforcement of coherence between the two private memories can be expensive and is not necessary in our scheme. DOE

N88-18318# Brookhaven National Lab., Upton, N. Y.
THE IMPLEMENTATION OF ARTIFICIAL INTELLIGENCE IN CONTROL SYSTEMS
R. Koul and D. P. Weygand 1987 12 p Presented at the Europhysics Conference on Control Systems for Experimental Physics, Villars, Switzerland, 28 Sep. 1987
(Contract DE-AC02-76CH-00016)
(DE88-003497; BNL-40314; CONF-8709151-9) Avail: NTIS HC A03/MF A01

Some concepts of artificial intelligence are reviewed, particularly as they apply to control systems of accelerators. Logical representation and formal reasoning are discussed briefly, as well as production systems, which describe various systems based on the idea of condition-action pairs (productions). Procedural knowledge, which deals with routine activities that rarely require change, is described. Frames are defined, which provide a convenient structure for representing knowledge. Frames consist of information about objects. For a given frame there are various slots, and for each slot there are various facets, each containing various data. Direct analogical representation is defined as a class of representation which represents knowledge in a natural analog manner, allowing observation of facts in many cases to be achieved quickly and easily compared to deduction. Architecture of systems applied to accelerator control is then described. DOE

N88-18319# Brookhaven National Lab., Upton, N. Y.
THE REPRESENTATION OF KNOWLEDGE WITHIN MODEL-BASED CONTROL SYSTEMS
D. P. Weygand and R. Koul 1987 11 p Presented at the Workshop on Model Based Accelerator Controls, Upton, N.Y., 16 Aug. 1987
(Contract DE-AC02-76CH-00016)
(DE88-004863; BNL-40592; CONF-8708145-5) Avail: NTIS HC A03/MF A01

Representation of knowledge in artificially intelligent (AI) systems is discussed. Types of knowledge that might need to be represented in AI systems are listed, and include knowledge about objects, events, knowledge about how to do things, and knowledge about what human beings know (meta-knowledge). The use of knowledge in AI systems is discussed in terms of acquiring and retrieving knowledge and reasoning about known facts. Different kinds of reasonings or representations are then described with some examples given. These include formal reasoning or logical representation, which is related to mathematical logic production systems, which are based on the idea of condition-action pairs (production), procedural reasoning, which uses pre-formed plans to solve problems, frames, which provide a structure for representing knowledge in an organized manner, and direct analogical representations, which represent knowledge in such a manner that some observation without deduction are permitted. DOE

N88-18320*# National Aeronautics and Space Administration. Ames Research Center, Moffett Field, Calif.
ORTHOGONAL PATTERNS IN BINARY NEURAL NETWORKS
Yoram Baram Mar. 1988 16 p
(NASA-TM-100060; A-88068; NAS 1.15:100060) Avail: NTIS HC A03/MF A01 CSCL 09B

A binary neural network that stores only mutually orthogonal patterns is shown to converge, when probed by any pattern, to a pattern in the memory space, i.e., the space spanned by the stored patterns. The latter are shown to be the only members of the memory space under a certain coding condition, which allows maximum storage of M=(2N) sup 0.5 patterns, where N is the number of neurons. The stored patterns are shown to have basins of attraction of radius N/(2M), within which errors are corrected with probability 1 in a single update cycle. When the probe falls outside these regions, the error correction capability can still be increased to 1 by repeatedly running the network with the same probe. Author

N88-18321# Maryland Univ., College Park.
NONLINEAR FILTERING AND LARGE DEVIATIONS: A PDE-CONTROL THEORETIC APPROACH
M. R. James and J. S. Baras 26 Feb. 1987 22 p
(Grants AF AFOSR-0073-87; NSF CDR-85-00108)
(AD-A187436; AFOSR-87-1438TR) Avail: NTIS HC A03/MF A01 CSCL 12D

We consider the asymptotic nonlinear filtering problem dx = f(x) dt + sq. rt. epsilon, dy = h(x) dt + sq. rt. epsilon, and obtain the limit as epsilon approaches 0 of epsilon log (q(xt) to the epsilon power) = -W(x,t) for unnormalized conditional densities (q(x,t)) to the epsilon power, using PDE methods. Here, W(x,t) is the value function for a deterministic optimal control problem arising in Mortensen's deterministic estimation, and is the unique viscosity solution of a Hamilton-Jacobi-Bellman equation. Hijab has also studied this filtering problem, and we extend his large deviation result for certain unnormalized conditional measures. The resulting variational problem corresponds to the above control problem. GRA

N88-18322# Massachusetts Inst. of Tech., Cambridge. Artificial Intelligence Lab.
HIERACHICAL OBJECT RECOGNITION USING LIBRARIES OF PARAMETERIZED MODEL SUB-PARTS M.S. Thesis
Gil J. Ettinger Jun. 1987 173 p
(Contract N00014-85-K-0124)
(AD-A187476; AI-TR-963) Avail: NTIS HC A08/MF A01 CSCL 12I

Described is the development of a model-based vision system that exploits hierarchies of both object structure and object scale. These hierarchies are used to achieve robust recognition based on effective organization and indexing schemes for model libraries. The goal is to recognize parameterized instances of non-rigid model objects contained in a large knowledge base despite the presence of noise and occlusion. Robustness is achieved by developing a system that can recognize viewed objects that are scaled or mirror-image instances of the known models or that contain component sub-parts with different relative scaling, rotation, or translation than in the models. The approach taken is to develop an object shape representation incorporating a component sub-part hierarchy to allow for efficient and correct indexing into an automatically generated model library as well as for relative

parameterization among sub-parts, and a scale hierarchy to allow for a general to specific recognition procedure. After analysis of the issues and inherent tradeoffs in the recognition process, a system is implemented using a representation based on significant contour curvature changes and a recognition engine based on geometric constraints of feature properties. GRA

N88-18323# Stanford Univ., Calif. Dept. of Computer Science.
KNOWLEDGE BASE REFINEMENT BY MONITORING ABSTRACT CONTROL KNOWLEDGE, REVISION 1
David C. Wilkins, William J. Clancey, and Bruce G. Buchanan Aug. 1987 22 p
(Contract N00014-85-K-0305; Proj. RR0-4206)
(AD-A187502; STAN-CS-87-1182-Rev-1; KSL-87-01) Avail: NTIS HC A03/MF A01 CSCL 12E

An explicit representation of the problem solving method of an expert system shell as abstract control knowledge provides a powerful foundation for learning. This paper describes the abstract control knowledge of the Heracles expert system shell for heuristic classification problems, and describes how the Odysseus apprenticeship learning program uses this representation to automate end-game knowledge acquisition. Particular emphasis is given to showing how abstract control knowledge facilitates the use of underlying domain theories by a learning program. GRA

N88-18324# Maryland Univ., College Park.
DYNAMIC OBSERVERS AS ASYMPTOTIC LIMITS OF RECURSIVE FILTERS: SPECIAL CASES
J. S. Baras, A. Bensoussan, and M. R. James 1 Dec. 1986 21 p
(Contract N00014-83-K-0731; Grant AF AFOSR-0073-87)
(AD-A187578; AFOSR-87-1439TR) Avail: NTIS HC A03/MF A01 CSCL 12B

The objective is to describe a method for constructing an observer for a certain dynamical system as the asymptotic limit of nonlinear filters associated with the noisy version of another document entitled Dynamic Observers as Asymptotic Limits of Recursive Filters. GRA

N88-18242# Worcester Polytechnic Inst., Mass. Dept. of Electrical Engineering.
REAL TIME ARTIFICIAL INTELLIGENCE ARCHITECTURE
Peter E. Green, Ronald J. Juels, and William R. Michalson (Raytheon Co., Sudbury, Mass.) *In* North Carolina Univ., Proceedings of the Workshop on Future Directions in Computer Architecture and Software 30 Aug. 1986 p 328-330 (For primary document see N88-18191 10-60)
Avail: NTIS HC A18/MF A01 CSCL 09B

64 NUMERICAL ANALYSIS

Includes iteration, difference equations, and numerical approximation.

N88-18325# North Carolina Univ., Chapel Hill. Center For Stochastic Processes.
EXPLICIT SOLUTIONS OF MOMENT PROBLEMS, 1 Technical Report, Sep. 1986 - Aug. 1987
Irina Kuznezova-Sholpo and Svetlozar T. Rachev Jul. 1987 29 p Prepared in cooperation with Saratov Univ., USSR and Bulgarian Academy of Sciences, Sofia
(Contract F49620-85-C-0144)
(AD-A186018; TR-197; AFOSR-87-1146TR) Avail: NTIS HC A03/MF A01 CSCL 12A

In probability theory the following two measure theoretic problems are well known: (1) Marginal problem: for fixed probability measurers (laws) P Sub 1 and P Sub 2 on a measurable space U and a measurable function c on the product space U Squared = U x U: and (2) Moment problem: for fixed real numbers a sub ij and real-valued continuous functions f sub ij (i = 1,2, j = l,...,n). This paper is devoted to the explicit solutions of some moment problems on separable metric space U with metric d. GRA

N88-18326# Argonne National Lab., Ill.
APPLICATION OF A MULTIGRID METHOD TO A BUOYANCY-INDUCED FLOW PROBLEM
C. P. Thompson, G. K. Leaf, and S. P. Vanka Oct. 1987 31 p
(Contract W-31-109-eng-38)
(DE88-003961; ANL-87-46) Avail: NTIS HC A03/MF A01

The numerical prediction of buoyancy-induced flows provides special difficulties for standard numerical techniques associated with velocity-buoyancy coupling. We present a multigrid algorithm based upon a novel relaxation scheme that handles this coupling correctly. Numerical experiments have been performed that show that this approach is reasonably efficient and robust for a range of Rayleigh numbers and a variety of cycling strategies. DOE

N88-18327# Oak Ridge National Lab., Tenn.
APPLICATION OF ONSAGER'S RECIPROCITY RELATIONS TO INTERFACE MOTION
T. Kaplan, M. J. Aziz, and L. J. Gray Nov. 1987 7 p Presented at the Fall Meeting of the Materials Research Society, Boston, Mass., 30 Nov. 1987 Prepared in cooperation with Harvard Univ., Cambridge, Mass.
(Contract DE-AC05-84OR-21400)
(DE88-003286; CONF-871124-16) Avail: NTIS HC A02/MF A01

A requirement of any theory for the kinetics of interface motion during a phase transformation is that it satisfies Onsager's reciprocity relations. In this paper we show how to apply Onsager's relations to a phase transformation mediated by a moving interface in a two-component system. We use the result to evaluate two proposed models for interface motion during alloy solidification. DOE

N88-18328# Illinois Univ., Urbana. Center for Supercomputing Research and Development.
FAST AND PRACTICAL PARALLEL POLYNOMIAL INTERPOLATION
Omer Egecioglu, E. Gallopoulos, and Cetin K. Koc Jan. 1987 32 p Sponsored in part by Lawrence Livermore National Lab., and IBM Corp.
(Contracts W-7405-eng-48; DE-FG02-85ER-25001; N00014-85-K-0551; Grants NSF DCR-86-03722; NSF DCR-84-10110; NSF DCR-85-09770; AF-AFOSR-85-0211)
(DE88-003530; DOE/ER-25001/89; CSRD-646) Avail: NTIS HC A03/MF A01

Fast and practical parallel algorithms are presented for the computation and evaluation of interpolating polynomials. The algorithms make use of fast parallel prefix techniques for the calculation of divided differences in the Newton representation of the interpolating polynomial. For n + 1 given input pairs the proposed interpolation algorithm requires 2 (log (n + 1)) + 2 parallel arithmetic steps and circuit size O(n sup 2). The algorithms are numerically stable and their floating-point implementation results in error accumulation similar to that of the widely used serial algorithms. This is in contrast to other fast serial and parallel interpolation algorithms which are subject to much larger roundoff. We demonstrate that in a distributed memory environment context, a cube connected system is very suitable for the algorithms' implementation, exhibiting very small communication cost. As further advantages we note that our techniques do not require equidistant points, preconditioning, or use of the Fast Fourier Transform. DOE

N88-18329# Argonne National Lab., Ill.
A MULTIGRID PRECONDITIONER APPLIED TO A TWO-DIMENSIONAL CONVECTION-DIFFUSION PROBLEM
K. E. Jordan and A. Bayliss Nov. 1987 13 p
(Contract W-31-109-eng-38)
(DE88-004765; ANL/MCS-TM-101) Avail: NTIS HC A03/MF A01

We consider a preconditioner for convective diffusion problems based on a small number of sweeps of a multi-grid applied only to the diffusion part of the operator. The preconditioner is applied to the normal equations, and the conjugate gradient method is

used as the iteration scheme. This extends a preconditioner which has been shown to be effective for Helmholtz type equations. The numerical experiments indicate that best convergence is obtained using only a small number of sweeps of the multi-grid algorithm and that this preconditioner may be more effective than a fast solver for the diffusion part of the operator. DOE

N88-18330# Gosudarstvennyi Komitet po Ispolzovaniyu Atomnoi Energii, Obninsk (USSR). Fiziko-Ehnergeticheskij Inst.
QUASIGROUP APPROACH TO SOLUTION OF LINEAR ALGEBRAIC EQUATION SYSTEMS
B. D. Abramov 1986 12 p In RUSSIAN
(DE88-700595; FEI-1787) Avail: NTIS (US Sales Only) HC A03/MF A01

The paper deals with some family of iterative nonstationary calculation algorithms of linear functional set determined with assigned accuracy on solutions of the system of linear algebraic equations occurring during numerical simulation of neutron, quantum, heat transfer. These algorithms represent generalization of corresponding algorithms of neutron transfer theory, applied for approximation of energy dependences, therefore the considered approach is called as a quasigroup one. It is similar to the methods of convergence acceleration using enlarged grids, methods of variation synthesis etc. The suggested algorithms can be applied for solution of grid equation systems, typical for the problems of neutron transfer theory: as algorithms of energy group consolution, as algorithms of preparing effective factors of large grid, preserving the assigned functional set when passing from the problem on small grid, as algorithms of convergence acceleration of other iterative methods for solution of similar equations, etc. DOE

N88-18331*# Texas Univ. at Dallas, Richardson. Programs in Mathematical Sciences.
PARALLELS BETWEEN CONTROL PDE'S (PARTIAL DIFFERENTIAL EQUATIONS) AND SYSTEMS OF ODE'S (ORDINARY DIFFERENTIAL EQUATIONS)
L. R. Hunt and Ramiro Villarreal [1987] 9 p
(Grant NAG2-366)
(NASA-CR-182487; NAS 1.26:182487) Avail: NTIS HC A02/MF A01 CSCL 12A

System theorists understand that the same mathematical objects which determine controllability for nonlinear control systems of ordinary differential equations (ODEs) also determine hypoellipticity for linear partial differentail equations (PDEs). Moreover, almost any study of ODE systems begins with linear systems. It is remarkable that Hormander's paper on hypoellipticity of second order linear p.d.e.'s starts with equations due to Kolmogorov, which are shown to be analogous to the linear PDEs. Eigenvalue placement by state feedback for a controllable linear system can be paralleled for a Kolmogorov equation if an appropriate type of feedback is introduced. Results concerning transformations of nonlinear systems to linear systems are similar to results for transforming a linear PDE to a Kolmogorov equation. Author

N88-18332*# National Aeronautics and Space Administration. Langley Research Center, Hampton, Va.
LEAPFROG VARIANTS OF ITERATIVE METHODS FOR LINEAR ALGEBRA EQUATIONS Final Report
Paul E. Saylor Jan. 1988 63 p Submitted for publication
(Contract NAS1-18107; Grant AF AFOSR-0189-85)
(NASA-CR-181616; ICASE-88-7; NAS 1.26:181616) Avail: NTIS HC A04/MF A01 CSCL 12A

Two iterative methods are considered, Richardson's method and a general second order method. For both methods, a variant of the method is derived for which only even numbered iterates are computed. The variant is called a leapfrog method. Comparisons between the conventional form of the methods and the leapfrog form are made under the assumption that the number of unknowns is large. In the case of Richardson's method, it is possible to express the final iterate in terms of only the initial approximation, a variant of the iteration called the grand-leap method. In the case of the grand-leap variant, a set of parameters is required. An algorithm is presented to compute these parameters that is related to algorithms to compute the weights and abscissas for Gaussian quadrature. General algorithms to implement the leapfrog and grand-leap methods are presented. Algorithms for the important special case of the Chebyshev method are also given. Author

N88-18333# National Academy of Sciences - National Research Council, Washington, D. C.
INTERDISCIPLINARY RESEARCH IN MATHEMATICS, SCIENCE AND TECHNOLOGY EDUCATION
1987 98 p
(Grant NSF SPE-84-70489)
(PB88-131446) Avail: NTIS HC A05/MF A01 CSCL 12A

The role of interdisciplinary research is discussed, as well as research needs in science and mathematics education, experience with interdisciplinary research, and research program alternatives. GRA

N88-18334# Vrije Universiteit, Amsterdam (Netherlands). Subfaculteit Wiskunde en Informatica.
STRONGLY SEQUENTIAL TERM REWRITING SYSTEMS
J. W. Klop and A. Middeldorp Jun. 1987 41 p
(PB88-126693; IR-128) Avail: NTIS HC A03/MF A01 CSCL 12A

For regular term rewriting systems, G. Huet and J.-J. Levy have introduced the property of strong sequentiality. A strongly sequential regular term rewriting system admits an efficiently computable normalizing one-step reduction strategy. As shown by Huet and Levy, strong sequentiality is a decidable property. A structural analysis is presented of strongly sequential term rewriting systems, leading to two new and simplified proofs of the decidability of the property. Author

N88-18335# Vrije Universiteit, Amsterdam (Netherlands). Subfaculteit Wiskunde en Informatica.
VECTOR BUNDLES OVER REAL ALGEBRAIC VARIETIES
J. Bochnak, M. Buchner, and W. Kucharz 1987 50 p Prepared in cooperation with New Mexico Univ., Albuquerque
(Grant NSF DMS-86-02672)
(PB88-126677; Rept-323) Avail: NTIS HC A03/MF A01 CSCL 12A

Let X be an affine real algebraic variety and let h(X) be the ring of regular R-valued functions on X. Let F denote one of the fields R, C or H (quaternions). The following is studied: Problem - Given X, charaterize continuous F-vector bundles over X admitting an algebraic structure. Author

N88-18336# Vrije Universiteit, Amsterdam (Netherlands). Subfaculteit Wiskunde en Informatica.
STRAIGHTENING AND THE STANLEY DECOMPOSITION FOR THE (2;n)-NILPOTENT VECTORFIELD
N. White, R. Cushman, and J. A. Sanders 15 May 1987 25 p Prepared in cooperation with Florida Univ., Gainesville
(PB88-126685; Rept-324) Avail: NTIS HC A03/MF A01 CSCL 12A

An algorithm is given for finding the normal form of formal power series vectorfields on (R sup 2n) whose linear terms are the nilpotent matrix made up of 2x2 Jordan blocks. The problem is reduced to finding the Stanley decomposition of a bracket algebra, which is then determined using a straightening algorithm. The 4- and 6-dimensional case are explicitly worked out. Author

N88-18337# Technische Hogeschool, Delft (Netherlands). Afd. der Elektrotechniek.
CONJUGATE GRADIENT SPECTRAL ITERATIVE TECHNIQUE
P. M. vandenBerg and R. E. Kleinman May 1987 30 p Prepared in cooperation with Delaware Univ., Newark
(PB88-126917; Rept-1987-14) Avail: NTIS HC A03/MF A01 CSCL 12A

It is shown that the Spectral Iterative Technique (SIT) to solve the integral equation is nothing but a Neumann iterative solution of a related Fredholm integral equation of the second kind. This

latter integral equation is obtained from the original one through some linear operations utilizing the convolution structure of the original operator. It is thus shown that SIT only converges when the norm of the modified operator is small enough. Applying a conjugate gradient technique to this modified integral equation, a convergent iterative scheme is arrived at. Some representative numerical results show a superiority in the rate of convergence of the conjugate gradient scheme for the modified integral equation (CGSIT-scheme) when compared with the convergence of the conjugate scheme for the original integral equation (CG-scheme). Author

N88-18338# Technische Hogeschool, Delft (Netherlands). Afd. der Elektrotechniek.

SPECTRAL ITERATIVE TECHNIQUE WITH GRAM-SCHMIDT ORTHOGANALIZATION

P. M. vandenBerg and W. J. Ghijsen Apr. 1987 24 p
(PB88-127451; Rept-1987-10) Avail: NTIS HC A03/MF A01
CSCL 12A

Some interative schemes based on the minimization of the integrated square error are discussed. In each iteration, a basis function is generated in such a way that it is linearly related to the residual error of the previous iteration. A complete orthogonalization of all of these basis functions leads to an optimal convergent scheme for some choices of the basis functions. In order to reduce the computer storage needed to store all of the basis functions, an incomplete orthogonalization scheme is presented that still yields an efficient computational method. In the scheme, a limited number of basis functions has to be stored. Some numerical results with respect to some representative field problems illustrate the performance of the various versions of the iterative schemes suggested. Author

N88-18339# Vrije Universiteit, Amsterdam (Netherlands). Subfaculteit Wiskunde en Informatica.

COMPUTATION OF THE ZETA-FUNCTION OF AN ALGEBRAIC CURVE WITH THE DIFFERENTIALS OF THE FIRST KIND

E. J. Ditters Apr. 1987 61 p
(PB88-127527; Rept-319) Avail: NTIS HC A04/MF A01
CSCL 12A

A method is given that may be useful for the computation of the numerator of the zeta function of an algebraic curve of genus greater than or = to 1 over the prime field, using expansions of differentials of the first kind in a nonsingular point on the curve and congruences of Atkin-Swinnerton-Dyer type. The methods are based on the techniques of Hilbert functions and Witt functions. Using these techniques, the congruences are replaced by an identity, involving a structure constant of these Hilbert functions. If the Hasse Witt matrix of the curve is invertible or identically zero, then the numerator of the zeta function effectively may be computed by the method. Author

N88-18340# Illinois Univ., Urbana. Center for Supercomputing Research and Development.

FAST POISSON SOLVER ON IRREGULAR REGIONS BY BOUNDARY INTEGRAL-BASED DOMAIN DECOMPOSITION METHODS

D. Lee and E. Gallopoulos Jul. 1987 5 p Presented at the 3rd SIAM Conference on Parallel Processing for Scientific Computing, Los Angeles, Calif., 1 Dec. 1987
(Contract DE-FG02-85ER-25001)
(DE88-003583; DOE/ER-25001/78; CONF-871251-1) Avail: NTIS HC A02/MF A01

A method for a fast solution of the Poisson equation on irregular regions is proposed. The method, which may be called the Boundary Integral-based Domain Decomposition (BIDD) method, seems to be particularly efficient for parallel processing of large scale boundary value problems. For instance, in a hierachical multiprocessor system like the Cedar architecture, each cluster and each processor of a cluster can solve an independent subproblem resulting from the BIDD approach. DOE

N88-18341# Los Alamos National Lab., N. Mex.

THE HYBRID MONTE CARLO ALGORITHM AND THE CHIRAL TRANSITION

R. Gupta 1987 10 p Presented at the International Symposium on Field Theory on the Lattice, Seillac, France, 28 Sep. 1987
(Contract W-7405-eng-36)
(DE88-004305; LA-UR-87-4146; CONF-8709225-3) Avail: NTIS HC A02

Described are tests of the Hybrid Monte Carlo Algorithm for QCD. It is found that the acceptance in the global Metropolis step for Staggered fermions can be tuned and kept large without having to make the step-size prohibitively small. Results are presented for the finite temperature transition on 4^4 and 4×6^3 lattices using this algorithm. DOE

N88-18342# Illinois Univ., Urbana. Dept. of Computer Science.

POLYNOMIAL PRECONDITIONING FOR CONJUGATE GRADIENT METHODS

S. F. Ashby Dec. 1987 137 p
(Contract DE-FG02-87ER-25026)
(DE88-005214; DOE/ER-25026/8-12/87; UIUCDCS-R-87-1355)
Avail: NTIS HC A07/MF A01

The solution of a linear system of equations, Ax = b, arises in many scientific applications. If A is large and sparse, an iterative method is required. When A is hermitian positive definite (hpd), the conjugate gradient method of Hestenes and Stiefel is popular. When A is hermitian indefinite (hid), the conjugate residual method may be used. If A is ill-conditioned, these methods may converge slowly, in which case a preconditioner is needed. In this thesis we examine the use of polynomial preconditioning in CG methods for both hermitian positive definite and indefinite matrices. Such preconditioners are easy to employ and well-suited to vector and/or parallel architectures. We first show that any CG method is characterized by three matrices: an hpd inner product matrix B, a preconditioning matrix C, and the hermitian matrix A. The resulting method, CG(B,C,A), minimizes the B-norm of the error over a Krylov subspace. We next exploit the versatility of polynomial preconditioners to design several new CG methods. To obtain an optimum preconditioner, we solve a constrained minimax approximation problem. The preconditioning polynomial, C(lambda), is optimum in that it minimizes a bound on the condition number of the preconditioned matrix, p(sub m)(A). An adaptive procedure for dynamically determining the optimum preconditioner is also discussed. Finally, in a variety of numerical experiments, conducted on a Cray X-MP/48, we demonstrate the effectiveness of polynomial preconditioning. DOE

N88-18343*# National Aeronautics and Space Administration. Ames Research Center, Moffett Field, Calif.

A STUDY OF NUMERICAL METHODS FOR HYPERBOLIC CONSERVATION LAWS WITH STIFF SOURCE TERMS

R. J. LeVeque (Washington Univ., Seattle.) and H. C. Yee Mar. 1988 24 p
(NASA-TM-100075; A-88110; NAS 1.15:100075) Avail: NTIS HC A03/MF A01 CSCL 12A

The proper modeling of nonequilibrium gas dynamics is required in certain regimes of hypersonic flow. For inviscid flow this gives a system of conservation laws coupled with source terms representing the chemistry. Often a wide range of time scales is present in the problem, leading to numerical difficulties as in stiff systems of ordinary differential equations. Stability can be achieved by using implicit methods, but other numerical difficulties are observed. The behavior of typical numerical methods on a simple advection equation with a parameter-dependent source term was studied. Two approaches to incorporate the source term were utilized: MacCormack type predictor-corrector methods with flux limiters, and splitting methods in which the fluid dynamics and chemistry are handled in separate steps. Various comparisons over a wide range of parameter values were made. In the stiff case where the solution contains discontinuities, incorrect numerical propagation speeds are observed with all of the methods considered. This phenomenon is studied and explained. Author

N88-18344*# National Aeronautics and Space Administration. Ames Research Center, Moffett Field, Calif.
HYPERSONIC BLUNT BODY COMPUTATIONS INCLUDING REAL GAS EFFECTS
J.-L. Montagne, H. C. Yee, G. H. Klopfer, and M. Vinokur (Sterling Software, Palo Alto, Calif.) Mar. 1988 18 p
(NASA-TM-100074; A-88109; NAS 1.15:100074) Avail: NTIS HC A03/MF A01 CSCL 12A

The recently developed second-order explicit and implicit total variation diminishing (TVD) shock-capturing methods of the Harten and Yee, Yee, and van Leer types in conjunction with a generalized Roe's approximate Riemann solver of Vinokur and the generalized flux-vector splittings of Vinokur and Montagne for two-dimensional hypersonic real gas flows are studied. A previous study on one-dimensional unsteady problems indicated that these schemes produce good shock-capturing capability and that the state equation does not have a large effect on the general behavior of these methods for a wide range of flow conditions for equilibrium air. The objective of this paper is to investigate the applicability and shock resolution of these schemes for two-dimensional steady-state hypersonic blunt body flows. The main contribution of this paper is to identify some of the elements and parameters which can affect the convergence rate for high Mach numbers or real gases but have negligible effect for low Mach number cases for steady-state inviscid blunt body flows. Author

N88-18345*# National Aeronautics and Space Administration. Langley Research Center, Hampton, Va.
DOMAIN DECOMPOSITION PRECONDITIONERS FOR THE SPECTRAL COLLOCATION METHOD Final Report
Alfio Quarteroni and Giovanni SacchiLandriani (Consiglio Nazionale delle Ricerche, Pavia, Italy) Jan. 1988 38 p Submitted for publication
(Contract NAS1-18107)
(NASA-CR-181620; ICASE-88-11; NAS 1.26:181620) Avail: NTIS HC A03/MF A01 CSCL 12A

Several block iteration preconditioners are proposed and analyzed for the solution of elliptic problems by spectral collocation methods in a region partitioned into several rectangles. It is shown that convergence is achieved with a rate which does not depend on the polynomial degree of the spectral solution. The iterative methods here presented can be effectively implemented on multiprocessor systems due to their high degree of parallelism. Author

N88-18346*# National Aeronautics and Space Administration. Langley Research Center, Hampton, Va.
A UNIFIED FRAMEWORK FOR APPROXIMATION IN INVERSE PROBLEMS FOR DISTRIBUTED PARAMETER SYSTEMS Final Report
H. T. Banks and K. Ito Jan. 1988 34 p Submitted for publication
(Contract NAS1-18107; Grant NAG1-517)
(NASA-CR-181621; ICASE-88-12; NAS 1.26:181621) Avail: NTIS HC A03/MF A01 CSCL 12A

A theoretical framework is presented that can be used to treat approximation techniques for very general classes of parameter estimation problems involving distributed systems that are either first or second order in time. Using the approach developed, one can obtain both convergence and stability (continuous dependence of parameter estimates with respect to the observations) under very weak regularity and compactness assumptions on the set of admissible parameters. This unified theory can be used for many problems found in the recent literature and in many cases offers significant improvements to existing results. Author

N88-18347# Maryland Univ., College Park. Inst. for Physical Science and Technology.
RECENT PROGRESS IN THE p AND h-p VERSION ON THE FINITE ELEMENT METHOD Final Report
I. Babuska Jul. 1987 20 p
(Contract N00014-85-K-0169)
(AD-A187254; BN-1067) Avail: NTIS HC A03/MF A01 CSCL 12A

The finite element method has become the main tool in computational mechanics. The success is manifested by the development of over five hundred user-oriented finite element program systems. The literature on the subject is overwhelming. To date there are over two hundred monographs and conference proceedings and new monographs and proceedings are continuously appearing. Various forms of the finite element method are used in practice for the numerical treatment of elliptic, parabolic, hyperbolic, linear and nonlinear partial differential equations, integral and integrodifferential equations, etc. Any class of problems has its own specific features. This paper deals with the class of partial differential equation of elliptic type. For the sake of simplicity the author elaborates on a characteristic model problem and illustrative results and makes only additional comments of more general nature although the results referred to are general. GRA

N88-18348# Maryland Univ., College Park. Inst. for Physical Science and Technology.
THE h-p VERSION OF THE FINITE ELEMENT METHOD FOR PROBLEMS WITH NONHOMOGENEOUS ESSENTIAL BOUNDARY CONDITION Final Report
Babuska, Ivo and B. Q. Guo Sep. 1987 87 p
(Contract N00014-85-K-0169; Grant NSF DMS85-16191)
(AD-A187356; BN-1069) Avail: NTIS HC A05/MF A01 CSCL 12B

The paper analyzes the spaces B-sq(Omega) sub beta and the associated trace spaces on the boundary delta Omega. These spaces are essential in the theory of the h-p version of the finite element method. The h-p version of the problem with nonhomogeneous essential and natural boundary conditions is analyzed. Numerical experimentation is presented. GRA

N88-18349# Pan American Univ., Edinburg, Tex.
BOUNDARY VALUE PROBLEMS FOR DIFFERENTIAL AND FUNCTIONAL DIFFERENTIAL EQUATIONS Final Report, 1 Jul. 1984 - 30 Jun. 1987
Joseph Wiener 31 Aug. 1987 18 p
(Contract DAAG29-84-G-0034)
(AD-A187378; ARO-21704.23-MA) Avail: NTIS HC A03/MF A01 CSCL 12B

Boundary value problems are studied for ordinary and functional differential equations. Emphasis is made on equations with piecewise constant delay important in control theory. Existence-uniqueness theorems are proved, stability behavior investigated, unusually interesting oscillatory and periodic properties discovered. GRA

N88-18350# Maryland Univ., College Park.
IDENTIFIABILITY OF MULTIVARIATE ARMA MODELS
Shuyuan He Sep. 1987 19 p
(Contract N00014-86-K-0007; Grant AF AFOSR-0187-82)
(AD-A187394) Avail: NTIS HC A03/MF A01 CSCL 12C

This paper proved that multivariate ARMA models are identifiable. Some properties of Multivariate ARMA models were given. GRA

N88-18351# Maryland Univ., College Park.
ON OBSERVER PROBLEMS FOR SYSTEMS GOVERNED BY PARTIAL DIFFERENTIAL EQUATIONS
J. S. Baras and A. Bensoussan 30 Jul. 1987 22 p
(Grants AF AFOSR-0073-87; NSF ECS-82-19123; NSF INT-84-93793)
(AD-A187430; AFOSR-87-1440TR) Avail: NTIS HC A03/MF A01 CSCL 12A

The problem of observers has been introduced in the control literature by Luenberger. Let us consider a dynamic system which is deterministic, but whose initial state is unknown. An observer is a model which mimics the behavior of the physical system, and in particular its state becomes closer and closer as time evolves to the state of the physical system. There is a great deal of freedom

in such a design and it is important to investigate various kinds of observers. GRA

N88-18352# Maryland Univ., College Park.
ON AN OVERDETERMINED NEUMANN PROBLEM
Carlos A. Bernstein 30 Jul. 1987 7 p
(Grant AF AFOSR-0073-87)
(AD-A187451; AFOSR-87-1442TR) Avail: NTIS HC A02/MF A01 CSCL 12B

Several questions in harmonic analysis, partial differential equations and applied mathematics lead to the question of characterizing domains for which overdetermined boundary value problems have solutions. In the theorem let M = R superscript n (resp. H superscript n), the existence of infinitely many eigenvalues for either of the problems (D) or (N) characterizes the balls (resp. geodesic balls) among all the relatively compact domains omega with connected Lipshitz boundary. GRA

N88-18353# Virginia Polytechnic Inst. and State Univ., Blacksburg. Dept. of Mathematics.
TIME DELAYS AND BOUNDARY FEEDBACK STABILIZATION IN ONE-DIMENSIONAL VISCOELASTICITY, APPENDICES A THROUGH H Interim Scientific Report
Kenneth B. Hannsgen and Robert L. Wheeler Oct. 1987 217 p
(Grants AF AFOSR-0085-86; NSF DMS-85-00947)
(AD-A187534; AFOSR-87-1604TR-App-A-H) Avail: NTIS HC A10/MF A01 CSCL 12A

Following is a list of the contents of Appendices A through H: Time Delays and Boundary Feedback Stabilization in One Dimensional Viscoelasticity; Boundary Control of Timoshenko Beams; Existence and Decay Estimates for Boundary Feedback Stabilization of Torsional Vibrations in a Viscoelastic Rod; Effectiveness and Robustness with Respect to Time Delays of Boundary Feedback Stabilization in One Dimensional Viscoelasticity; On the Initial Boundary Value Problem for a Bingham Fluid in a Three Dimensional Domain; Semidiscretization Method for Three Dimensional Motion of a Bingham Fluid; On Robustness of Controllability for Finite Dimensional Approximations of Distributed Parameter Systems; On the Shape of the Solutions of Second Order Parabolic Partial Differential Equations. GRA

N88-18354# Virginia Polytechnic Inst. and State Univ., Blacksburg. Dept. of Mathematics.
WELL-POSEDNESS AND SPECTRAL ESTIMATION FOR INFINITE DIMENSIONAL SYSTEMS Final Report, 15 Sep. 1984 - 15 Sep. 1987
C. A. Beattie and T. L. Herdman 28 Sep. 1987 5 p
(Grant AF AFOSR-0326-84)
(AD-A187621; AFOSR-87-1578TR) Avail: NTIS HC A02/MF A01 CSCL 01A

A mathematical model is developed for the motions of an airfoil, with flap, in a two dimensional unsteady flow of an inviscid, incompressible fluid. Necessary and sufficient conditions are established for the well-posedness for a large class of functional differential equations containing those used to model the aeroelastic system. Significant progress has been made in developing efficient numerical approaches for resolving intermediate problems. Further work has provided refined rate estimates for the closure of spectral estimates and a formulation for resonances of sparse frame structures has been developed and tested. GRA

N88-18355# Maryland Univ., College Park.
SMALL DEGREE SOLUTIONS FOR THE POLYNOMIAL BEZOUT EQUATION
Carlos A. Berenstein, Daniele C. Struppa, and Scuola N. Superiore 30 Jul. 1987 23 p
(Grant AF AFOSR-0073-87)
(AD-A187630; TR-86-74; AFOSR-87-1441TR) Avail: NTIS HC A03/MF A01 CSCL 12A

The purpose of this paper is to briefly report on some new advances due to Brownawell on the problem of explicit (concretely computable) solutions to the Bezout equations, which are based on recent developments in complex analysis due to Yger and the authors. GRA

N88-18356# Maryland Univ., College Park. Inst. for Physical Science and Technology.
EIGENVALUE PROBLEMS Final Report
I. Babuska and J. Osborn Jun. 1987 237 p
(Contract N00014-85-K-0169; Grant NSF DMS-85-16191)
(AD-A188069) Avail: NTIS HC A11/MF A01 CSCL 12A

This section presents several model eigenvalue problems arising in physics and engineering. Specifically discussed are some important physical interpretations of eigenvalues and eigenfunctions. Some of the model problems discussed here will serve as illustrative examples in connection with the approximation methods considered later. A clear understanding of the fundamental ideas is presented, but not a detailed treatment. For a more complete discussion of the material in this section refer to Courant-Hilbert 1953. GRA

N88-18357# Loyola Univ., Chicago, Ill. Dept. of Mathematical Sciences.
VISCOSITY METHODS IN OPTIMAL CONTROL OF DISTRIBUTED SYSTEMS Annual Technical Report, 1 Aug. 1986 - 15 Aug. 1987
Emmanuel N. Barron 15 Aug. 1987 4 p
(Grant AF AFOSR-0202-86)
(AD-A188086; AFOSR-87-1827TR) Avail: NTIS HC A02/MF A01 CSCL 12D

The rigorous connection between viscosity solutions for the Bellman equation in optimal control and the Pontryagin Maximum Principle has been established. The method developed for controlled ordinary differential equations was extended to infinite dimensions to derive the Pontryagin principle for: (1) a class of controlled nonlinear evolution equations in a Hilbert space, (2) a class of controlled nonlinear, divergence form parabolic partial differential equations; and (3) a class of differential-difference equations. Additional subjects studied were the extension of the idea of viscosity solution to equations with only time-measureable Hamiltonians and the optimal cooling of a free boundary problem with Stefan problem dynamics. Two problems of interest in specific applications were solved. The optimal control is characterized in the class of monotone functions which minimizes the H1 distance to a given function. This problem, a specific monotone follower problem, arises in production planning. An optimal portfolio selection problem is considered which includes stock, options, bonds and borrowed cash at an interest rate different from the bond interest rate. This problem is formulated using stochastic optimal control and explicitly constructed the solution of the Bellman equation. The objective of the study was to derive the option price which the market sets to minimize the investor's maximal expected utility of wealth. GRA

N88-18358# Massachusetts Inst. of Tech., Cambridge. Lab. for Information and Decision Systems
STABLE, ROBUST TRACKING BY SLIDING MODE CONTROL
George C. Verghese, Benito Fernandez, and J. K. Hedrick May 1987 13 p
(Contract DAAG29-84-K-0005; Grant AF AFOSR-0258-82)
(AD-A188278; LIDS-P-1666; AFOSR-87-1611TR) Avail: NTIS HC A03/MF A01 CSCL 12A

Sliding mode control is examined from the perspective of obtaining stable and robust tracking of an arbitrary time-varying reference by a multi-input-output, linear, time-invariant system driven by a certain class of bounded errors, nonlinearities and disturbances. Most exciting schemes for such systems are subsumed by the one presented here. The results are developed via the use of inverse models, and make clear the constraints imposed by the finite and infinite zero structure of the system. In particular, stable and robust tracking is shown to be obtained by the scheme in this paper if and only if the system is minimum phase. GRA

N88-17834# Messerschmitt-Boelkow-Blohm G.m.b.H., Ottobrunn (West Germany). Zentralbereich Technik.
THE MATHEMATIZATION OF THE MILITARY SCIENCES [DIE MATHEMATISIERUNG DER KRIEGSWISSENSCHAFTEN]
Ottokar Pospischil *In its* Research and Development. Technical-Scientific Publications (1956-1987): Retrospective View and Prospects. Jubilee Edition on the Occasion of the 75th Anniversary of Dipl.-Engr. Dr.-Engr. E.H. Ludwig Boelkow 1987 p 107-110 In GERMAN (For primary document see N88-17819 10-31)
(MBB-Z-139/87) Copyright Avail: NTIS HC A14/MF A01

65 STATISTICS AND PROBABILITY

Includes data sampling and smoothing; Monte Carlo method; and stochastic processes.

N88-18359# Los Alamos National Lab., N. Mex.
ON PRECISION AND ACCURACY (BIAS) STATEMENTS FOR MEASUREMENT PROCEDURES
L. A. Bruckner, M. W. Hume, and W. L. Delvin Jan. 1988 28 p
(Contract W-7405-eng-36)
(DE88-004434; LA-11190-MS) Avail: NTIS HC A03/MF A01

Measurement procedures are often required to contain precision and accuracy of precision and bias statements. This paper contains a glossary that explains various terms that often appear in these statements as well as an example illustrating such statements for a specific set of data. Precision and bias statements are shown to vary according to the conditions under which the data were collected. This paper emphasizes that the error model (an algebraic expression that describes how the various sources of variation affect the measurement) is an important consideration in the formation of precision and bias statements. DOE

N88-18360# Massachusetts Inst. of Tech., Lexington. Lincoln Lab.
A TWO-STAGE ISOLATED-WORD RECOGNITION SYSTEM USING DISCRIMINANT ANALYSIS
Edward A. Martin 5 Aug. 1987 59 p
(Contract F19628-85-C-0002)
(AD-A187425; TR-773) Avail: NTIS HC A04/MF A01 CSCL 25D

Described is a two-stage isolated-word recognition system using a Hidden Markov Model (HMM) recognizer in the first stage, and a statistical discriminator in the second stage. The second-stage system performs pairwise discriminations between the top few candidate word models when no clear decision is made from the first stage. Likelihood-ratio comparisons and a new technique called sifting are used to focus attention on those features that best differentiate word pairs. This system alleviates four fundamental problems found with most conventional speech recognition systems, including: (1) the effects of limited training data are not explicitly taken into account, (2) the correlation between adjacent observation frames is incorrectly modeled, (3) durations of acoustic events are poorly modeled, and (4) features which might be important in discriminating only among specific work pairs or sets of words are not easily incorporated into the system without degrading overall performance. The system was tested on a 35 word/10,000 token stressed-speech isolated-word data base created at Lincoln Laboratory. The adding of the second-stage discriminating system reduced the error rate by more than a factor of 2. The overall error rate fell from 7.7 percent with only the HMM system to 3.5 percent with both the HMM system and the discriminator. GRA

N88-18361# Stanford Univ., Calif. Dept. of Statistics.
ASYMPTOTIC EXPANSIONS FOR LARGE DEVIATION PROBABILITIES IN THE STRONG LAW OF LARGE NUMBERS
James A. Fill Oct. 1987 28 p
(Contract N00014-87-K-0078)
(AD-A187432; TR-4) Avail: NTIS HC A03/MF A01 CSCL 12C

Let X sub 1, X sub 2,...be a sequence of independent random variables with common distribution function F having zero mean, and let (S sub n) be the random walk of partial sums. The weak and strong laws of large numbers, respectively, imply that for any alpha epsilon IR and epsilon greater than O the probabilities P(S sub m greater than alpha + epsilon m) and P sub m = P(S sub n greater than alpha + epsilon n for some n greater than or = m) tend to 0 as m tends to infinity. Building on work of Bahadur and Ranga Rao, the author produces complete asymptotic expansions for the probabilities P(S sub m greater than alpha + epsilon m) and P sub m. GRA

N88-18362# Stanford Univ., Calif. Dept. of Statistics.
THE CONVERGENCE RATE FOR THE STRONG LAW OF LARGE NUMBERS: GENERAL LATTICE DISTRIBUTIONS
James A. Fill and Michael J. Wichura Oct. 1987 34 p Prepared in cooperation with Chicago Univ., Ill.
(Contract N00014-87-K-0078)
(AD-A187560; TR-3) Avail: NTIS HC A03/MF A01 CSCL 12C

Let X1, X2, be a sequence of independent random variables with common lattice distribution function F having zero mean, and let (S Sub n) be the random walk of partial sums. The strong law of large numbers (SLLN) implies that for any alpha an element of IR and epsilon greater than 0 P sub m : = P(Sub n greater than alpha + (epsilon X n) for some n greater than or = decreases to 0 as m increases to infinity. Under conditions on the moment generating function of F, we obtain the convergence rate by determining P sub m up to asymptotic equivalence. When alpha = 0 and epsilon is a point in the lattice for F, the result is due to Siegmund; but this restriction on epsilon precludes all small values of epsilon, and these values are the most interesting vis-a-vis the SLLN. Even when alpha = 0 result handles important distributions F for which Siegmund's result is vacuous, for example, the two-point distribution F giving rise to simple symmetric random walk on the integers. GRA

N88-18363# Virginia Univ., Charlottesville. Dept. of Electrical Engineering.
A QUEUEING SYSTEM WITH INDEPENDENT MARKOV INPUT STREAMS Technical Report, 1 Jan. - 31 Dec. 1987
I. Stavrakakis and D. Dazakos 1987 20 p
(Grant AF AFOSR-0095-87)
(AD-A187601; UVA/525677/EE87/101; AFOSR-87-1619TR)
Avail: NTIS HC A03/MF A01 CSCL 12C

A discrete time single server queueing system with arbitrary (finite) number of input streams, is considered. The input streams are assumed to be independent but successive arrivals in a single stream are not. More specifically, it is assumed that for each stream, arrivals are governed by an underlying finite state space Markov chain and that a visit to a state corresponds to one or none arrivals, according to a stationary mapping rule. The first in-first out service policy is adopted. For the system described above we develop a method to calculate the average number of customers in the queuing system. Then, the mean time that a customer spends in the system is calculated by using Little's theorem. GRA

N88-18364# South Carolina Univ., Columbia. Dept. of Statistics.
A GENERALIZED QUANTILE ESTIMATOR UNDER CENSORING
Y. L. Lio and W. J. Padgett Feb. 1987 26 p
(Contract MIPR-ARO-139-85; Grant AF-AFOSR-0156-84)
(AD-A188280; TR-124; AFOSR-87-1617TR) Avail: NTIS HC A03/MF A01 CSCL 12C

Based on right-censored data from a lifetime distribution F sub 0, a smooth alternative to the product-limit estimator is a generalized product-limit quantile obtained by averaging appropriate subsample product-limit quantiles over all subsamples of a fixed size. Under the random censorship model and some conditions of F sub 0, it is shown that the estimator is consistent and has the same asymptotic normal distribution since the product-limit quantile

estimator performs better than the product-limit quantile estimator in the sense of estimated mean squared errors. GRA

N88-17829# Boelkow-Entwicklingen K.G., Stuttgart (West Germany). Entwicklungsfachabteilung Flugmechanik.
DEPENDENCE OF THE EXPECTANCY OF HITTING ON THE NUMBER OF SPREAD SHOTS. DETERMINATION OF THE EXPECTANCY OF HITTING USING A SPREAD SALVO [ABHAENGIGKEIT DER TREFFERWAHRSCHEINLICHKEIT VON DER ANZAHL DER STREUSCHUESSE. ERMITTLUNG DER TREFFERWAHRSCHEINLICHKEIT MITTELS FAECHERSCHUSS]
Hans-George Knoche *In* MBB GmbH, Research and Development. Technical-Scientific Publications (1956-1987): Retrospective View and Prospects. Jubilee Edition on the Occasion of the 75th Anniversary of Dipl.-Engr. Dr.-Engr. E.H. Ludwig Boelkow 1987 p 75-78 In GERMAN (For primary document see N88-17819 10-31)
(Rept-FM6; Rept-FM24) Copyright Avail: NTIS HC A14/MF A01

N88-17830# Boelkow-Entwicklingen K.G., Stuttgart (West Germany). Abteilung Triebwerke.
INVESTIGATION OF SEVERAL SPREAD SHOT CONDITIONS [UEBER DIE UNTERSUCHUNG VERSCHIEDENER BEZIEHUNGEN BEIM STREUSCHUSS]
Franz-R. Thomanek *In* MBB GmbH, Research and Development. Technical-Scientific Publications (1956-1987): Retrospective View and Prospects. Jubilee Edition on the Occasion of the 75th Anniversary of Dipl.-Engr. Dr.-Engr. E.H. Ludwig Boelkow 1987 p 79-86 In GERMAN (For primary document see N88-17819 10-31)
(Rept-TR-164) Copyright Avail: NTIS HC A14/MF A01

66 SYSTEMS ANALYSIS

Includes mathematical modeling; network analysis; and operations research.

N88-18365# Los Alamos National Lab., N. Mex.
WHERE DIRECTED ENERGY STANDS IN STRATEGIC DEFENSE
G. H. Canavan and J. C. Browne Jan. 1988 28 p
(Contract W-7405-eng-36)
(DE88-005092; LA-11172-MS) Avail: NTIS HC A03/MF A01

Directed energy concepts can play unique, significant roles in strategic defense. This report reviews the various stages in their prior development, assesses their current status, and indicates the key indicators of offensive system development that determine the time frame in which they will be needed. Directed energy concepts are significantly less sensitive to kinetic energy countermeasures, for which they could be ready. DOE

N88-18366*# National Aeronautics and Space Administration. Ames Research Center, Moffett Field, Calif.
LINEAR PREDICTION OF STATIONARY VECTOR SEQUENCES
Yoram Baram Mar. 1988 14 p
(NASA-TM-100069; A-88087; NAS 1.15:100069) Avail: NTIS HC A03/MF A01 CSCL 12B

The class of all linear predictors of minimal order for a stationary vector-valued process is specified in terms of linear transformations on the associated Hankel covariance matrix. Two particular transformations, yielding computationally efficient construction schemes, are proposed. Author

N88-17835# Messerschmitt-Boelkow-Blohm G.m.b.H., Ottobrunn (West Germany). Zentralbereich Technik.
OPERATIONS RESEARCH IN MANAGEMENT? [OPERATIONS RESEARCH IN DER UNTERNEHMENSFUEHRUNG?]
Guenther Itzelsberger *In its* Research and Development. Technical-Scientific Publications (1956-1987): Retrospective View and Prospects. Jubilee Edition on the Occasion of the 75th Anniversary of Dipl.-Engr. Dr.-Engr. E.H. Ludwig Boelkow 1987 p 111-114 In GERMAN (For primary document see N88-17819 10-31)
(MBB-Z-138/87) Copyright Avail: NTIS HC A14/MF A01

N88-17860# Messerschmitt-Boelkow-Blohm G.m.b.H., Ottobrunn (West Germany). Unternehmensgruppe Wehrtechnik.
THE MILITARY TECHNIQUES OF TOMORROW. A CONTRIBUTION TO ACTIVE PEACE ASSURANCE [DIE WEHRTECHNIK VON MORGEN - EIN BEITRAG ZUR AKTIVEN FRIEDENSSICHERUNG]
Roland Mecklinger *In its* Research and Development. Technical-Scientific Publications (1956-1987): Retrospective View and Prospects. Jubilee Edition on the Occasion of the 75th Anniversary of Dipl.-Engr. Dr.-Engr. E.H. Ludwig Boelkow 1987 p 274-278 In GERMAN (For primary document see N88-17819 10-31)
(MBB-UA-1049/87) Copyright Avail: NTIS HC A14/MF A01

67 THEORETICAL MATHEMATICS

Includes topology and number theory.

N88-18367# Hiroshima Univ., Takehara (Japan). Research Inst. for Theoretical Physics.
COMMENT ON THE ADLER-BARDEEN THEOREM AND RELATED PROBLEMS
Kazuo Fujikawa Jun. 1987 13 p
(DE88-751051; RRK-87-10) Avail: NTIS (US Sales Only) HC A03/MF A01

Some aspects of the constructive proof of the Adler-Bardeen theorem in the sense of exact bare identities are discussed by using the higher derivative regularization. It is argued that the formal path integral derivation of chiral and scale (counting identity) anomalies is compatible with the construction of those regularized Green's functions. We also comment on the T*-product in the Lagrangian formalism and discuss how the complications associated with the (anomalous) symmetry charges in the operator approach are avoided in a suitably defined path integral formalism. DOE

N88-18368# Sandia National Labs., Albuquerque, N. Mex.
A COMPONENT SYNTHESIS METHOD USING LANCZOS VECTORS
J. J. Allen 1987 24 p Presented at the 6th International Modal Analysis Conference, Orlando, Fla., 1 Feb. 1988
(Contract DE-AC04-76DP-00789)
(DE88-002263; SAND-87-1551C; CONF-880220-3) Avail: NTIS HC A03/MF A01

A component synthesis technique has been developed, which uses a combination of constraint modes and fixed interface Lanczos vectors. The sequence of Lanczos vectors are obtained via a recursion equation similar to inverse iteration and mass orthonormalized to the previously derived vectors. The static solution of a problem of interest or a set of random vectors can be used as the initial Lanczos vector in the sequence. The fixed interface Lanczos method produces a statically complete model for a given load, if the static solution is the first vector in the sequence. The subsequent Lanczos vectors, X/sub i/, in the sequence can be interpreted as being generated using the dynamic error, K/sup -1/MX/sub i-1/, of the previous vector. Including constraint modes for the boundary degrees of freedom retains physical degrees of freedom for the boundary, which allows the component to be incorporated into the system by direct matrix assembly. The convergence characteristics of the fixed interface Lanczos method is studied using static and transient analysis. Various criteria are examined for evaluating the convergence. The results of the fixed interface Lanczos method will be compared to the component mode synthesis method developed by Hurty. DOE

N88-18369# Virginia Polytechnic Inst. and State Univ., Blacksburg. Center for Transport Theory and Mathematical Physics.
APPLIED MATHEMATICS OF TRANSPORT THEORY Progress Report, 15 Mar. - 15 Nov. 1987
W. Greenberg and P. F. Zweifel 1987 8 p
(Contract DE-FG05-87ER-25033)
(DE88-004098; DOE/ER-25033/1) Avail: NTIS HC A02/MF A01

This progress report discusses research programs in transport theory. In particular, the research areas discussed are nonlinear kinetic equations, linear theory and specific transport models. DOE

N88-18370# Stanford Univ., Calif. Center for Large Scale Scientific Computation.
SCHWARZ SPLITTING AND TEMPLATE OPERATORS Ph.D. Thesis
Wei-Pai Tang Jul. 1987 39 p
(Contract N00014-82-K-0335)
(AD-A187956; CLASSIC-87-3) Avail: NTIS HC A03/MF A01 CSCL 12B

Schwarz alternating method (SAM) is an old mathematical technique dating from 1869. It was commonly believed that SAM was a useful tool for theoretical analysis but not a very practical approach for computations. The earlier experiences showed that SAM converged slowly. In this thesis, SAM is reexamined and generalized. The governing factors of convergence of SAM are explored through the analysis for the model problem. Based on this knowledge, many acceleration schemes can be combined with SAM to yield a new type of iterative method for large sparse matrix problems. In particular, when these techniques are applied to the solution of the model problem, an optimal complexity can be achieved. Some generalizations of SAM, namely Schwarz splittings (SS), are presented here. For many important applications, such as performing parallel computations in a non-shared memory environment, using composite grids and also applying fast solvers in an irregular region, (SS)s are found to be useful techniques. In order to identify the types of problems for which (SS)s are most suitable, a new structure for the linear operators called template operators has been developed. Some decay results for the elements of the inverses of sparse operators are given. These results provide a theoretical basis for determining when these SS techniques can be used successfully. GRA

N88-18371# North Carolina Univ., Chapel Hill. Center for Stochastic Processes.
PROBABILITY BOUNDS FOR M-SKOROHOD OSCILLATIONS Technical Report, 1 Oct. 1986 - 30 Sep. 1987
Florin Avram and Murrad S. Taqqu Dec. 1986 18 p
(Contract F49620-85-C-0144; Grant NSF ECS-86-96090)
(AD-A187981; TR-173; AFOSR-87-1004TR) Avail: NTIS HC A03/MF A01 CSCL 12B

Billingsley developed a widely used method for proving weak convergence with respect to the sup-norm and J -Skorohod topologies, once convergence of the finite-dimensional distributions has been established. Billingsley's method works not only for J oscillations, but also for M oscillations. This is done by identifying a common property of the J and M functions, called sub-triadditivity, and then showing that Billingsley's approach in the case of the J function can be adequately modified to apply to any sub-triadditive function. GRA

70 PHYSICS (GENERAL)

For precision time and time interval (PTTI) see *35 Instrumentation and Photography;* for geophysics, astrophysics or solar physics see *46 Geophysics, 90 Astrophysics,* or *92 Solar Physics.*

N88-18372# Los Alamos National Lab., N. Mex.
GENERALIZED EQUATIONS FOR EMITTANCE AND FIELD ENERGY OF HIGH-CURRENT BEAMS IN PERIODIC FOCUSING
I. Hofmann Dec. 1987 41 p
(Contract W-7405-eng-36)
(DE88-004448; LA-11132-MS) Avail: NTIS HC A03/MF A01

We derive a set of ordinary differential equations relating the rms emittance of a beam with its nonlinear field energy. The equations are valid in constant or periodic focusing and 1-D, 2-D, or 3-D and thus provide a general framework to study emittance growth. They allow us to estimate the expected total emittance growth, if the change of nonlinear field energy can be predicted from general principles, like the homogenization of charge density in beams that are space-charge dominated. Structure resonances in periodic focusing can be identified as a resonance between the envelope modulation and the oscillating nonlinear field-energy term. The equations lead to estimates for the maximum longitudinal-transverse emittance transfer in situations where equipartitioning occurs. DOE

71 ACOUSTICS

Includes sound generation, transmission and attenuation. For noise pollution see *45 Environmental Pollution.*

N88-18373# Aerospace Medical Research Labs., Wright-Patterson AFB, Ohio.
SUPERSONIC AND SUBSONIC AIRCRAFT NOISE EFFECTS ON ANIMALS: A LITERATURE SURVEY Final Report, 15 Oct. 1985 - 15 Oct. 1986
Robert C. Kull, Jr. and Alan D. Fisher 1 Dec. 1986 57 p
(AD-A186922; AAMRL-TR-87-032) Avail: NTIS HC A04/MF A01 CSCL 20A

We searched the literature concerning the effects of supersonic and subsonic aircraft noise on animals. Our search revealed many review papers of prior research accomplished, but few actual research papers. Out of all the reviews, Dufour's work is the most comprehensive. Many of the papers are anecdotal in nature and add little to our scientific knowledge - strictly circumstantial evidence. The literature reveals few effects on animals due to sonic booms. The effects of subsonic noise, however, needs much more investigation. One of the biggest problems with the research in this area is the lack of controls, lack of standardized ways of recording data and evaluating behaviors, and the number of variables involved. Specific recommendations to fill some of the technological gaps include a sonic boom study on a ground-nesting shorebird, effects of subsonic aircraft noise on endangered species, long term physiological effects causing immunosuppression, and noise versus visual aircraft stimuli effects. GRA

N88-18374# Institute of Paper Chemistry, Appleton, Wis.
ULTRASONIC CHARACTERIZATION OF LAYERED COMPOSITE SYSTEMS Ph.D. Thesis
Michael Fredric Forbes 1986 225 p
Avail: Univ. Microfilms Order No. DA8722621

Ultrasonic measurement techniques have provided a nondestructive method for determining the elastic properties of a material. These techniques are finding increased application in the testing of paper and paper board. It is generally assumed that these materials behave as homogeneous, orthotropic solids. For layered composites, this assumption is not valid. A layered orthotropic theory was developed to predict ultrasonic wave behavior in layered composites. To test this theory, a number of two and three layer handsheets were produced. Ultrasonic and mechanical tests were performed on all of the composite sheets and individual layers. It was found that the layered orthotropic theory accurately predicts the ultrasonic behavior of these composites. The in-plane and out-of-plane elastic constants for the composites could be calculated from the elastic constants of the individual layers. The mechanical measurements could also be related to the ultrasonic properties. These results may aid in the development of new ultrasonic test methods. Dissert. Abstr.

N88-18375# California Inst. of Tech., Pasadena.
MICROSCOPIC MODELING OF SOUND WAVES IN GRANULAR MATERIAL Quarterly Progress Report, 1 Oct. - 31 Dec. 1987
P. K. Haff 1987 3 p
(Contract DE-FG22-86PC-90959)
(DE88-000348; DOE/PC-90959/T4) Avail: NTIS HC A02/MF A01

In previous work we have studied via computer simulation the transmission of elastic disturbances through a quasi-consolidated grain mass, as well as through a mass of particles undergoing shear deformation. In the past quarter we have been developing the capability of modifying our earlier quasi-consolidated studies, where periodic waves were generated by an oscillating boundary, in order to focus on the radiation of elastic energy from a single point down through a drain mass to a transducer at the bed. The oscillating boundary studies hinted at the importance of columnar structure in the grain fabric, but the lateral extent of the excitation transducer inhibited analysis of the role of individual grain columns. In the present work, a layer of grains is allowed to settle on a horizontal surface. A cooling algorithm is employed to speed the settling rate, which otherwise takes a substantial amount of computer time (more on this below). When the grains have come to rest, a sharply located pulse is injected at the surface of the bed, in the form of a downward impulse applied to a grain. The lowest layer of particles on the bed are monitored for the arrival of the wave resulting from the surface disturbance. DOE

N88-18376*# Purdue Univ., West Lafayette, Ind. School of Mechanical Engineering.
SOUND TRANSMISSION THROUGH THE WALLS OF LIGHT AIRCRAFT: AN INVESTIGATION OF STRUCTURE-BORNE NOISE IN A HANDLEY PAGE 137 JETSTREAM 3 AIRCRAFT
R. J. Bernhard and C. Wohlever Jan. 1988 164 p
(Grant NAG1-58)
(NASA-CR-182509; NAS 1.26:182509; Rept-0353-10; HL-88-5; PRF-520-1288-0353) Avail: NTIS HC A08/MF A01 CSCL 20A

This study indicates that the structureborne noise due to wing/vortex interation for the Handley Page-137 Jetstream may be significant at frequencies above 500 Hz. It was found that by preventing such interaction, noise reductions between 1 to 3 dB were attainable. However, this study did not show any significant contribution due to this phenomena at the first blade passage tone. It is suspected that the wing/vortex interaction effect varies from plane to plane. Author

N88-18377# Technische Hogeschool, Delft (Netherlands). Afd. der Elektrotechniek.
SCATTERING OF IMPULSIVE ACOUSTIC WAVES BY A SEMI-INFINITE CRACK IN THE PLANE INTERFACE OF A HALF-SPACE AND A LAYER
B. J. Kooij Dec. 1986 85 p
(PB88-126396; Rept-1986-23) Avail: NTIS HC A05/MF A01 CSCL 20A

The problem investigated has its relevance to the quantitative nondestructive evaluation of mechanical structures. For the mechanical structure, a flat layered model is introduced. In the lower boundary of the layer a semi-infinite crack is present and the response of the configuration to an acoustic pulsed line source is requested with both source and observer located anywhere on the surface of the structure. The problem is modeled as a two dimensional acoustic diffraction problem suitable for the application of the Wiener-Hopf technique. Subsequently, a solution in the time domain due to a pulsed line source excitation is sought with the help of the modified Cagniard technique. Author

N88-18378# Lehigh Univ., Bethlehem, Pa. Dept. of Physics.
A MODIFIED VERSION OF THE PHASE SENSITIVE TECHNIQUE FOR MEASUREMENTS OF ABSOLUTE SOUND VELOCITY IN SOLIDS
J. Toulouse 1987 4 p
(Contract DE-FG02-86ER-45258)
(DE88-002303; DOE/ER-45258/T2) Avail: NTIS HC A02

Measurements of absolute sound velocity in solids can be performed automatically by the phase sensitive technique. This technique is based on the relationship between frequency changes and known phase shifts. Frequency changes, however, also result in unknown phase shifts due to reflections at the transducer-bond interface, and to dispersion in the sample. To avoid this problem, a modified version of the technique has been devised which is described here. Also reported are results of absolute velocity measurements using the new version, which are compared with similar measurements obtained with the old one. DOE

N88-18379*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.
AN ESTIMATE OF THE NOISE SHIELDING ON THE FUSELAGE RESULTING FROM INSTALLING A SHORT DUCT AROUND AN ADVANCED PROPELLER
James H. Dittmar Mar. 1988 14 p
(NASA-TM-100262; E-3891; NAS 1.15:100262) Avail: NTIS HC A03/MF A01 CSCL 20A

A simple barrier shielding model was used to estimate the amount of noise shielding on the fuselage that could result from installing a short duct around a wing-mounted advanced propeller. With the propeller located one-third of the duct length from the inlet, estimates for the maximum blade passing tone attenuation varied from 7 dB for a duct 0.25 propeller diameter long to 16.75 dB for a duct 1 diameter long. Attenuations for the higher harmonics would be even larger because of their shorter wavelengths relative to the duct length. These estimates show that the fuselage noise reduction potential of a ducted compared with an unducted propeller is significant. Even more reduction might occur if acoustic attenuation material were installed in the duct. Author

N88-18380# Massachusetts Inst. of Tech., Cambridge. Lab. for Information and Decision Systems.
INVERSION OF PARABOLIC AND PARABOLOIDAL PROJECTIONS
Ali Oezbek and Bernard C. Levy Apr. 1987 45 p
(Grants AF AFOSR-0227-85; NSF ECS-83-12921)
(AD-A187538; LIDS-P-1665; AFOSR-87-1605TR) Avail: NTIS HC A03/MF A01 CSCL 20A

The multidimensional inverse scattering problem for an acoustic medium is considered within the homogeneous background Born approximation. A constant density acoustic medium is probed by a wide-band plane wave source, and the scattered field is observed along a receiver array located outside the medium. The inversion problem is formulated as a generalized tomographic problem. It is shown that the observed scattered field can be appropriately filtered so as to obtain generalized projections of the scattering potential. For a 2-D experimental geometry, these projections are weighted integrals of the scattering potential over regions of parabolic support, whereas they become surface integrals over circular paraboloids for the 2-D case. The inversion problem is therefore similar to that of X-ray tomography, except that instead of being given projections of the object to be reconstructed along straight lines, parabolic or paraboloid projections are given. The inversion procedure that we propose is similar to the X-ray solution, in the sense that it consists of a backprojection operation followed by a 2- or 3-D space invariant filtering. An alternative interpretation of the backprojection operation in terms of a backpropagated field is given. A Projection-Slice Theorem is also derived relating the generalized projections and the scattering potential in the Fourier transform domain. GRA

N88-17841# Messerschmitt-Boelkow-Blohm G.m.b.H., Ottobrunn (West Germany). Abteilung Technologie-Entwicklung.
SILENCIUM RESONATORS (SILATORS) FOR THE ATTENUATION AND ELIMINATION OF SOUND [SILATOREN ZUR DAEMPFUNG UND DAEMMUNG VON SCHALL]
Oskar Bschorr and Eckehard Laudien *In its* Research and Development. Technical-Scientific Publications (1956-1987): Retrospective View and Prospects. Jubilee Edition on the Occasion of the 75th Anniversary of Dipl.-Engr. Dr.-Engr. E.H. Ludwig Boelkow 1987 p 141-146 In GERMAN (For primary document see

N88-17819 10-31)
(MBB-Z-546/83) Copyright Avail: NTIS HC A14/MF A01

72 ATOMIC AND MOLECULAR PHYSICS

Includes atomic structure, electron properties, and molecular spectra.

N88-18381# Lawrence Livermore National Lab., Calif.
PERFORMANCE AND OPTIMIZATION OF DIRECT IMPLICIT TIME INTEGRATION SCHEMES FOR USE IN ELECTROSTATIC PARTICLE SIMULATION CODES
R. J. Procassini, C. K. Birdsall, E. C. Morse, and B. I. Cohen 1988 29 p
(Contract DE-FG03-86ER-53220)
(DE88-003254; DOE/ER-53220/T4) Avail: NTIS HC A03/MF A01

Implicit time integration schemes allow for the use of larger time steps than conventional explicit methods, thereby extending the applicability of kinetic particle simulation methods. This paper will describe a study of the performance and optimization of two such direct implicit schemes, which are used to follow the trajectories of charged particles in an electrostatic, particle-in-cell plasma simulation code. The direct implicit method that was used for this study is an alternative to the moment-equation implicit method. DOE

N88-18382# Minnesota Univ., Minneapolis.
STATE-TO-STATE DYNAMICS OF MOLECULAR ENERGY TRANSFER Annual Performance Report, 1 Apr. 1987 - 31 Mar. 1988
W. R. Gentry 16 Nov. 1987 4 p
(Contract DE-FG02-86ER-13515)
(DE88-003282; DOE/ER-13515/3) Avail: NTIS HC A02/MF A01

An overview is given for the study of pure rotational excitation in I2 + He collisions, and experiments to explore the vibrational-rotational coupling which accompanies mode-selective vibrational excitation of polyatomic molecules. DOE

N88-18383# California State Univ., Fullerton. Dept. of Physics.
CORRELATED PROCESSES IN ATOMIC COLLISIONS Progress Report
J. M. Feagin 1987 7 p
(Contract DE-FG03-86ER-13521)
(DE88-003508; DOE/ER-13521/T1) Avail: NTIS HC A02/MF A01

This paper discusses works done at California State University in the following areas: highly correlated two-electron states and transfer and excitation collisions. DOE

N88-18384# Oak Ridge National Lab., Tenn.
APPLICATION OF ECR ION SOURCE BEAMS IN ATOMIC PHYSICS
F. W. Meyer 1987 27 p Presented at the International Conference on ECR Ion Sources and Their Applications, East Lansing, Mich., 16 Nov. 1987
(Contract DE-AC05-84OR-21400)
(DE88-003767; CONF-8711107-2) Avail: NTIS HC A03/MF A01

The availability of intense, high charge state ion beams from ECR ion sources has had significant impact not only on the upgrading of cyclotron and synchrotron facilities, but also on multicharged ion collision research, as evidenced by the increasing number of ECR source facilities used at least on a part time basis for atomic physics research. In this paper one such facility, located at the ORNL ECR source, and dedicated full time to the study of multicharged ion collisions, is described. Examples of applications of ECR ion source beams are given, based on multicharged ion collision physics studies performed at Oak Ridge over the last few years. DOE

N88-18385# Pacific Northwest Labs., Richland, Wash.
AN ANALYTIC MODEL FOR IONIZATION DISTRIBUTIONS PRODUCED IN NANOMETER SITES BY PROTONS
W. E. Wilson and H. G. Paretzke Sep. 1987 10 p Presented at the 6th Symposium on Neutron Dosimetry, Neuherberg, Fed. Republic of Germany, 12 Oct. 1987 Prepared in cooperation with Gesellschaft fuer Strahlen- und Umweltforschung m.b.H. Muenchen, Neuherberg, Fed. Republic of Germany
(Contract DE-AC06-76RL-01830)
(DE88-003943; PNL-SA-14875; CONF-871020-6) Avail: NTIS HC A02/MF A01

A concise mathematical model is presented for the microdosimetric ionization distributions produced in sub-cellular volumes by energetic protons of 0.3 to 20 MeV. The model is based on the results of extensive Monte Carlo computer simulations of high- linear energy transfer (LET) charged particle tracks and can be used to estimate, with only a modest computing effort, straggling and delta-ray transport effects in the nanometer dosimetry of high-LET radiations. DOE

N88-18386# New York Univ., New York.
ENERGY-RELATED ATOMIC AND MOLECULAR STRUCTURE AND SCATTERING STUDIES Final Report
1987 54 p
(Contract DE-AC02-78ER-04971)
(DE88-004246; DOE/ER-04971/8) Avail: NTIS HC A04/MF A01

The general goals of the DOE research concerned the use of molecular beams techniques in the study of atomic and molecular polarizabilities and the study of the interactions between electrons and highly polar molecules. Both of these goals are directly relevant to the general problem of the role played by long-range forces in atomic and molecular physics. Details related to this motivation can be found in the published literature. Here we will describe in general terms the work performed under DOE sponsorship in the atomic beams laboratory at NYU. Our original intent was to exploit techniques developed at NYU, mainly in the study of simple atomic systems, to the more complex atomic and molecular systems that are related to DOE interests. These included the developing understanding of the structure of molecular systems, particularly of alkali halide molecules, and the study of the interactions of electrons with such molecules. The structure experiments would serve as critical experimental benchmarks for computational techniques on molecular properties, including both molecular wave functions and derivative properties of them, such as vibrational and rotational constants, but in particular of molecular electric dipole polarizabilities. We believe that we have at least to some extent fulfilled these goals. DOE

N88-18387# Los Alamos National Lab., N. Mex. Chemistry and Laser Sciences Div.
ROVIBRATIONAL SPECTROSCOPY OF ArCO VAN DER WAALS COMPLEX
Edward J. Campbell, Anne DePiante Johnston, and Steven J. Buelow 1987 8 p Presented at the International Workshop on the Structure of Small Molecules and Ions, Neve Ilan, Israel, 13 Dec. 1987
(Contract W-7405-eng-36)
(DE88-004291; LA-UR-87-4227; CONF-871246-1) Avail: NTIS HC A02

The information that can be obtained from the high resolution rovibrational spectra of small molecular clusters is very useful for determining intermolecular potentials and the effects of intermolecular interactions on intramolecular bonds. Recently, such spectra was obtained via absorption measurements using F-center, frequency difference and diode laser sources. Because F-center and frequency difference lasers operate best in the 2 to 4 micron region, studies using these laser sources have involved high frequency vibrational modes (H-X, X-C,F,Cl,Br) or overtones. Although diode lasers cover a much broader spectral range (3 to 20 micron), they are less convenient to use for doing survey spectroscopy. We have developed several new techniques which improve the sensitivity and convenience of absorption

measurements using diode lasers for the study of molecular clusters in supersonic expansions. Here we describe these techniques and their application for the measurement of the rovibrational spectra of ArCO near 5 microns. DOE

N88-18388# Oak Ridge National Lab., Tenn.
TWO-PHOTON (VUV AND VISIBLE) RESONANT IONIZATION SPECTROSCOPY OF ATOMS AND MOLECULES
M. P. McCann, C. H. Chen, and M. G. Payne Dec. 1987 3 p Presented at the 3rd International Laser Science Conference, Atlantic City, N.J., 1 Nov. 1987
(Contract DE-AC05-84OR-21400)
(DE88-004332; CONF-871147-2) Avail: NTIS HC A02/MF A01

Two photon spectroscopy of argon, krypton and molecular hydrogen is considered in this paper. Experimental transition energies and two-photon rate constants are given. DOE

N88-18389# Vanderbilt Univ., Nashville, Tenn.
THEORETICAL STUDIES OF ATOMIC TRANSITIONS Progress Report, 15 Mar. 1985 - 14 Mar. 1988
C. FroeseFischer Sep. 1987 14 p
(Contract DE-AS05-80ER-10618)
(DE88-004719; DOE/ER-10618/22) Avail: NTIS HC A03/MF A01

Allowed and forbidden transitions have been studied for a number of atomic systems of interest in astrophysics, laser physics, or fusion research. All calculations have been based on the multiconfiguration Hartree-Fock (MCHF) method extended to include relativistic corrections in the Breit-Pauli approximation. The computer codes for this atomic structure software package were transferred to the CRAY supercomputer and modified for more convenient computation. Techniques were developed to enhance the range of problems considered, by either increasing the accuracy of prediction or increasing the complexity of problems considered. An example is the prediction of a bound state for Ca2 for which experimental evidence was inconclusive. Several different types of problems have been considered. A study of energy levels and lifetimes of a Rydberg series can given insight into electronic structure and explain deviations from regular behavior, and a number of such studies were performed. With the MCHF + Breit-Pauli approach it has been possible to determine a large portion of a spectrum. In core excited quartets of Na, autoionization along spin-orbit mixing and term dependence were all important in predicting lifetimes in excellent agreement with the most recent experiments. Some photoionization studies were performed which, like autoionization require the calculation of continuum functions. Finally, an attempt was made to combine the MCHF method with many-body perturbation theory so as to build on the strengths of both. DOE

N88-18390# Rice Univ., Houston, Tex. Nuclear Lab.
NUCLEAR STRUCTURE AT INTERMEDIATE ENERGIES Progress Report, 1 Apr. 1986 - 31 Mar. 1987
G. C. Phillips, G. S. Mutchler, and B. E. Bonner 15 Apr. 1987 119 p
(Contract DE-AS05-81ER-40032)
(TI88-002796; DOE/ER-40032/9) Avail: NTIS HC A06

This paper describes the following experimental accomplishments: spin transfer in hyperon production; data analysis of N-bar P annihilation cross sections near N-bar N threshold; data analysis on measurement of the imaginary part of the i = 1 N-bar N S-wave scattering length; and an investigation of the Ndelta interaction via the interaction pi(+)d yields pi(+)pn. DOE

N88-18391# Oak Ridge National Lab., Tenn.
ABSOLUTE RATE MEASUREMENTS OF TWO-PHOTON PROCESS OF GASES, LIQUIDS, AND SOLIDS
C. H. Chen, M. P. McCann, and M. G. Payne Dec. 1987 6 p Presented at the 3rd International Laser Science Conference, Atlantic City, N.J., 1 Nov. 1987
(Contract DE-AC05-84OR-21400)
(DE88-003800; CONF-871147-6) Avail: NTIS HC A02/MF A01

Due to rapid improvements in high-power laser performance, two-photon absorption processes have become a very useful tool for studying the molecular structures of various gases, liquids and solids. However, measurements of absolute two-photon absorption cross sections were more or less ignored previously because of their small size. In this work, we obtained not only the two-photon absorption spectra, but also measurements of their absolute cross sections for various gases, liquids, and solids. DOE

N88-18392# Toledo Univ., Ohio. Dept. of Physics and Astronomy.
SEMIEMPIRICAL STUDIES OF ATOMIC STRUCTURE Final Progress Report, 1 Jul. 1980 - 30 Jun. 1988
L. J. Curtis 15 Nov. 1987 31 p
(Contract DE-AS05-80ER-10676)
(DE88-004096; DOE/ER-10676/10) Avail: NTIS HC A03/MF A01

This paper discusses the following research: screening parameter studies of low lying strongly penetrating states, core polarization and penetration studies of Rydberg states, fast ion beam measurements, and calculational formulations. DOE

N88-18393# Arizona Univ., Tucson. Dept. of Chemistry.
CHEMICAL ACTIVATION OF MOLECULES BY METALS: EXPERIMENTAL STUDIES OF ELECTRON DISTRIBUTIONS AND BONDING Progress Report, period ending 28 Feb. 1988
D. L. Lichtenberger 15 Dec. 1987 21 p
(Contract DE-FG02-86ER-13501)
(DE88-004465; DOE/ER-13501/01) Avail: NTIS HC A03/MF A01

Results are reported in the following areas: fundamental principles of ionization energy/bond energy relationships; relative strengths of early transition metal M-H and M-C bonds in substituted niobocenes and tantalocenes. Thermodynamic trends and electronic factors of olefin insertion into a metal-hydride bond; additivity of ligand electronic effects. Complete phosphine substitution of Group VI metal hexacarbonyls; organometallic methylene-bridged metal dimers; delocalization of metal electron density in metallacycle formation; metal-heteroatom and metal-alkylidyne multiple bonds; the electronic factors favoring intermediates in acetylene metathesis and polymerization; improvements in an electron energy analyzer. DOE

N88-18394# Oak Ridge National Lab., Tenn.
ELECTRONIC STRUCTURE OF RANDOM ALLOYS AND THE THEORY OF ORDERING PROCESSES
G. M. Stocks, D. M. Nicholson, F. J. Pinski, D. D. Johnson, and A. Gonis 1987 13 p Presented at the US-Japan Seminar on Electronic Structure and Lattice Defects in Alloys, Honolulu, Hawaii, 4 May 1987 Prepared in cooperation with NRL, Washington, D.C. and Lawrence Livermore National Lab., Calif.
(Contract DE-AC05-84OR-21400)
(DE88-004476; CONF-8705226-2) Avail: NTIS HC A03/MF A01

Some of the approaches toward obtaining an understanding of alloy phase stability within the context of ab initio density functional theory are discussed. Recent results of calculations, using the concentration functional theory of Gyorffy and Stocks, of the spinodal for Pd(sub c)Rh(sub 1-c) alloys are presented. Short-range order diffuse scattering patterns in Al(sub c)Ag(sub 1-c) show that the intersite interactions change from clustering to ordering with increasing silver content. Implications of these results for the phase diagram of Al(sub c)Ag(sub 1-c) alloys and for Guinier-Preston zone formation in aluminum-rich alloys are briefly discussed. In conclusion, some conjectures about what the future might hold regarding first-principles theories of phase stability are made. DOE

N88-18395# State Univ. of New York, Albany. Dept. of Chemistry.
LIGHT ABSORPTION BY AN ATOM MOVING INSIDE A SPHERICAL BOX
Isidore Last and Thomas F. George Sep. 1987 25 p

(Contract N00014-86-K-0043)
(AD-A187241; UBUFFALO/DC/87/TR-53) Avail: NTIS HC A03/MF A01 CSCL 20C

The radiative transition for an atom moving inside a spherical box is considered in the terms of electronic-field states. By using the hopping model, an analytical expression is obtained by numerical integration of the time-dependent Schrodinger equations. GRA

N88-18396# Massachusetts Inst. of Tech., Cambridge. Research Lab. of Electronics
FORCES ON NEUTRAL ATOMS DUE TO ELECTROMAGNETIC FIELDS Annual Summary Report, 1 Sep. 1986 - 31 Aug. 1987
David E. Pritchard Sep. 1987 5 p
(Contract N00014-83-K-0695)
(AD-A187461) Avail: NTIS HC A02/MF A01 CSCL 20C

The superconducting magnetic trap was completed and, as a major breakthrough in the field, used to trap large numbers of neutral sodium atoms approx. 10 to the 9th power for periods of several minutes. This represented an advance of several orders of magnitude compared to previous neutral trapping experiments, both in the number of trapped atoms, and in trapping times achieved. This continuous loading process represents an important advance over previous pulsed loading schemes, permitting the accumulation of much larger numbers of atoms in the trap. The fluorescence spectra of the trapped atoms is studied using a weak probe laser beam (I =(I sub sat/10,000)), which does not affect the trapped atoms appreciably. Doppler cooling of the trapped atoms is studied to measure the temperature of the atomic sample. Observed for the first time is the effect of gravity on trapped atoms: the trapped atoms do not accumulate at the minimum of the magnetic field, but at the minimum of the total mechanical potential obtained when including the effect of gravity. RF resonance will be used to study the trapped atoms, and optical RF cyclic cooling of the atoms will be used to attempt to achieve temperatures less than or equal to .000001K. GRA

73 NUCLEAR AND HIGH-ENERGY PHYSICS

Includes elementary and nuclear particles; and reactor theory.

For space radiation see *93 Space Radiation.*

N88-18397# Texas Univ., Austin. Dept. of Physics.
RESEARCH IN EXPERIMENTAL NUCLEAR PHYSICS Progress Report, 1 Apr. 1987 - 31 Mar. 1988
C. F. Moore Nov. 1987 15 p
(Contract DE-FG05-87ER-40343)
(DE88-004100; DOE/ER-40343/1) Avail: NTIS HC A03/MF A01

The research activities discussed in this paper involve experiments done with the Energetic Pion Channel and Spectrometer (EPICS), the Low Energy Pion Channel (LEP), the Pion Particle Physics Channel (P^3), and the High Resolution Spectrometer (HRS). DOE

74 OPTICS

Includes light phenomena; and optical devices.

For lasers see *36 Lasers and Masers.*

N88-18398*# Photometrics, Inc., Tucson, Ariz.
NEW GENERATION IMAGER SYSTEM Final Report
15 Aug. 1986 138 p
(Contract NAS5-29284)
(NASA-CR-180464; NAS 1.26:180464; SBIR-0801-8961) Avail: NTIS HC A01/MF A01 CSCL 20F

The objectives of the Phase I SBIR research proposal (0801-8961) were to study the feasibility of developing a new generation high resolution, low light level scientific Charge Coupled Device (CCD) imaging system employing the Tektronix TK2048M series 2048x2048 pixel CCD. This was to be achieved through electronic and electro-optical characterization of the very similar medium resolution TK512M-011 device and identification of the problems anticipated in transferring the technology employed to operate the medium resolution sensor to the higher resolution device. One major goal in this proposal was to accurately assess the performance of the output FET of the Tektronix CCDs and develop an amplification system which would have a noise floor dominated by the output FET, not the amplifier. Author

N88-18399# Naval Research Lab., Washington, D.C.
MULTIDIMENSIONAL SYSTEM ANALYSIS OF ELECTRO-OPTIC SENSORS WITH SAMPLED DETERMINISTIC OUTPUT Interim Report
M. S. Longmire and D. A. Scribner 18 Dec. 1987 45 p
(AD-A187083; NRL-MR-6106) Avail: NTIS HC A03/MF A01 CSCL 20F

System descriptions of scanning and staring electro-optic sensors with sampled output are developed as follows. Functions representing image formation, detector response, and analog processing of detector output are formulated in the space and time domain. Then the types of sampling permitted by sensor motion, spatial integration of image irradiance, and temporal integration of sensor output are discussed. Next, functions representing sensor output sampled in each of these ways are constructed. The relations for a staring sensor describe a temporal sequence of images; those for a scanning sensor represent a single sampled image. Finally, the space and time domain functions are Fourier transformed to the spatial-and temporal-frequency domain to complete the system descriptions. The results should be useful for designing electro-optic sensor systems and correcting data for instrumental effects and other experimental conditions. GRA

N88-18400# Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of High Energy.
FAILURE-RESISTANT FIBRE-OPTICAL COMMUNICATION LINE (FOCL)
Yu. I. Romanov 1986 7 p In RUSSIAN
(DE88-700470; JINR-13-86-566) Avail: NTIS (US Sales Only) HC A02/MF A01

A 3-channel failure-resistant apparatus for digital information transfer via fiber-optical communication lines (FOCL) is described. The FOCL channels are constructed according to the following circuit: an optical transmitter with paraphase output - a double-optical line - a different optical receiver. They are used for data transfer without applying coding over a range of frequencies from 0 to 100 kHz. The FOCL length is 10 m. The range of operating temperatures is +5...+45 deg C. DOE

N88-18401# National Bureau of Standards, Gaithersburg, Md. Center for Radiation Research.
NBS (NATIONAL BUREAU OF STANDARDS) MEASUREMENT SERVICES: SPECTRAL IRRADIANCE CALIBRATIONS Final
J. H. Walker, R. D. Saunders, J. K. Jackson, and D. A. McSparron Sep. 1987 106 p
(PB88-123781; NBS/SP-250/20; LC-87-619862) Avail: NTIS HC A06/MF A01; also available SOD HC $5.50 as 003-003-02829-1 CSCL 20F

The report describes the measurement methods and instrumentation used in the realization and transfer of the NBS scale of spectral irradiance. The basic measurement equation for the irradiance realization is derived. The spectral responsivity function, linearity of response, and size of source effect of the spectroradiometer are described. The analysis of sources of error and estimates of uncertainty are described. The assigned uncertainties (3-sigma level) in spectral irradiance range from 2.2 percent at 250 nm to 1.0 percent at 654.6 nm to 6.5 percent at 2400 nm. GRA

N88-18402# Lawrence Livermore National Lab., Calif.
FABRICATION AND EVALUATION OF TRANSMISSIVE MULTILAYER OPTICS FOR 8 keV X-RAYS
R. M. Bionta, A. F. Jankowski, and D. M. Makowiecki 1 Dec. 1987 16 p Presented at the Fall Meeting of the Materials Research Society, Boston, Mass., 30 Nov. 1987
(Contract W-7405-eng-48)
(DE88-003999; UCRL-96783; CONF-871124-21) Avail: NTIS HC A03/MF A01

We have investigated an alternative technique for fabricating zone plates that operate in the 5 to 10 keV regime. Ultimately we plan to make zone plates by sputtering alternating layers of opaque and transparent materials onto a thin wire core, then slicing perpendicular to the core axis to produce many zone plates. This technique shows promise for making X-ray optical elements that can be used in industrial crystallography, microprobe and radiography equipment. In a previous publication we reported on the favorable comparison between the measured performance of an Al/Ta diffraction grating and our numerical simulation. In this report we concentrate on the fabrication techniques used to produce diffraction gratings and linear zone plates. DOE

N88-18403# Bern Univ. (Switzerland). Inst. fuer Angewandte Physik.
THE 80 fsec SOLITON-LIKE PULSES FROM AN OPTICAL-NONLINEAR FIBER RESONATOR
B. Zysset, P. Beaud, W. Hodel, and H. P. Weber 8 Aug. 1986 9 p Presented at the Ultrafast Phenomena, Springer Series in Chemical Physics Conference, Snowmass, Colo., 16-20 Jun. 1986
(PB88-127303; MM:1986/87-Zy-1) Avail: NTIS HC A02/MF A01 CSCL 20F

Selfcompressed pulses of 100 fsec duration at 1.38 micrometers are generated in a nonlinear fiber oscillator pumped by 1 psec pulses from a dye laser at 1.323 micrometers. GRA

N88-18404# Los Alamos National Lab., N. Mex.
LOS ALAMOS OPTICAL MATERIALS RELIABILITY, MAINTAINABILITY, AND EXPOSURE TESTING PROGRAM Data Report, 1985
S. W. Moore Oct. 1987 26 p
(Contract W-7405-eng-36)
(DE88-001953; LA-11128-SR) Avail: NTIS HC A03/MF A01

This report presents observations of solar collector materials exposed to the environment. Data presented are gathered as part of an ongoing investigation described in earlier reports. DOE

N88-18405# Los Alamos National Lab., N. Mex.
OPTICAL MEASUREMENTS OF SURFACE OXIDE LAYER FORMATION ON METAL FILMS
Marion L. Scott 1987 8 p Presented at the 19th Annual Symposium on Optical Materials for High Power Lasers, Boulder, Colo., 26 Oct. 1987
(Contract W-7405-eng-36)
(DE88-003163; LA-UR-87-3888; CONF-8710254-1) Avail: NTIS HC A02

We have employed two optical techniques which give complementary indications of the formation of monolayers of oxide on freshly evaporated aluminum and silicon thin films. Visible ellipsometry is utilized to observe the growth of the initial monolayer of oxide on these films. From these data, we deduce the pressure and coverage dependence as well as the growth rate for the initial monolayer arising from these surface reactions. In addition, extreme ultraviolet (XUV) reflectance vs angle of incidence measurements at 58.4 nm wavelength clearly indicate the growth of oxide on the surface of our freshly deposited aluminum and silicon films as well. We have utilized this reflectance data to deduce the optical constants of aluminum and silicon at 58.4 nm. We find that previous XUV measurements of these optical constants were hampered by the presence of oxides. We also determined that the XUV reflectivity performance of aluminum films freshly deposited in our UHV system does not degrade appreciably when stored for four weeks in a helium atmosphere of 2 x 10 to the minus 9th power Torr. DOE

N88-18406# Oak Ridge National Lab., Tenn.
ADVANCES IN CALCULATING MACROIONIC SOLUTION STRUCTURE
J. B. Hayter 1987 13 p Presented at the 19th Yamada Conference on Ordering and Organization in Ionic Solutions, Kyoto, Japan, 9 Nov. 1987
(Contract DE-AC05-84OR-21400)
(DE88-003799; CONF-8711123-1) Avail: NTIS HC A03/MF A01

The techniques of light scattering and small-angle X-ray and neutron scattering have provided prodigious quantities of structural data on a wide variety of colloidal systems in the past decade. Much of this data cannot be analyzed in the absence of a quantitative treatment of the correlations generated in such systems by interparticle interactions. This has led to a pressing need for statistical mechanical descriptions of macroionic solutions which require computational times short compared with typical experimental measurement times. This paper discusses in detail one of the most widely used techniques, the rescaled mean spherical approximation, in the context of the one-component macrofluid model. DOE

N88-18407# Oak Ridge National Lab., Tenn.
FORMATION OF OPTICAL WAVEGUIDES BY ION IMPLANTATION
D. B. Poker 20 Nov. 1987 41 p
(Contract DE-AC05-84OR-21400)
(DE88-003894; DOE/OR-21400/T325) Avail: NTIS HC A03/MF A01

The use of ion implantation to introduce Ti into LiNbO sub 3 for the production of optical waveguides offers several advantages over the use of thermal diffusion. Higher concentrations and steeper gradients of dopant can be obtained, while reducing processing times and temperatures. However, the implantation process amorphizes the substrate, which must be regrown by solid phase epitaxy. This epitaxy was found to be extremely sensitive to the dopant species and concentration, which led to a search for species with better annealing characteristics. Though Ag and Pb allow regrowth at lower temperatures, the tendency of Ti to oxidize during regrowth is essential for the retention of dopant during annealing. Thus, the dopant exhibiting the slowest epitaxial regrowth ultimately produces the best waveguides. DOE

N88-18408# Los Alamos National Lab., N. Mex.
A CHEMICAL PRECURSOR TO OPTICAL DAMAGE. STUDIES BY LASER IONIZATION MASS SPECTROMETRY
N. S. Nogar and R. C. Estler 1987 10 p Presented at the Boulder Damage Symposium, Boulder, Colo., 26 Oct. 1987
(Contract W-7405-eng-36)
(DE88-004321; LA-UR-87-4002; CONF-8710165-5) Avail: NTIS HC A02/MF A01

Mass spectrometry has been used in conjunction with Nomarski microscopy to characterize the initiation of optical damage in selected commercial optics. For a sample with an Al2O3/SiO2 multilayer coating (351 nm) on a Si substrate, results suggest layer by layer removal of the coating material with low-fluence irradiation at 1.06 microns. In addition, carbon impurities were observed in the low-damage threshold sample. For the Sc2O3/SiO2 multilayer coated (351 nm) 7940 substrates, transient iron signals were observed at each increasing fluence level, with concomitant appearance of small circular (10 micron) pits in the surface. These pits were also associated with macroscopic damage features due to threshold testing. DOE

N88-18409# Naval Postgraduate School, Monterey, Calif.
DESIGN AND IMPLEMENTATION OF A FIBER OPTIC RS232 LINK M.S. Thesis
James W. Ryan Sep. 1987 93 p
(AD-A187319) Avail: NTIS HC A05/MF A01 CSCL 20F

This thesis investigates the feasibility of using a bi-directional fiber optic link to implement a RS232 data link. The results showed that a fiber optic link is a viable replacement. It offers a bandwidth up to 5 MHz, 250 times that of a RS232 data link. This fiber optic

link was tested over a distance of 1.5 kilometers, nearly 100 times that of the present RS232 link. It also offers the benefits of space and weight savings and is comparable to devices produced commercially but at a substantial cost savings. GRA

N88-18410# Massachusetts Inst. of Tech., Cambridge. Artificial Intelligence Lab.
RELAXING THE BRIGHTNESS CONSTANCY ASSUMPTION IN COMPUTING OPTICAL FLOW
Michael A. Gennert and Shahriar Negahdaripour Jun. 1987 26 p
(Contracts N00014-85-K-0124; DACA76-85-C-0100)
(AD-A187437; AI-MEMO-975) Avail: NTIS HC A03/MF A01 CSCL 17E

Optical flow is the apparent (or perceived) motion of image brightness patterns arising from relative motion of objects and observer. Estimation of the optical flow requires the application of two kinds of constraint: the flow field smoothness constraint and the brightness constancy constraint. The brightness constancy constraint permits one to match image brightness values across images, but is very restrictive. We propose replacing this constraint with a more general constraint, which permits a linear transformation between image brightness values. The transformation parameters are allowed to vary smoothly, so that inexact matching is allowed. The implementation on a highly parallel computer, is described, sample results presented. GRA

N88-18411# City Univ. of New York, N.Y. Inst. for Ultrafast Spectroscopy and Lasers.
SUBPICOSECOND OPTICAL DIGITAL COMPUTATION USING PHASE CONJUGATE PARAMETRIC GENERATORS Annual Final Report, Dec. 1986 - Aug. 1987
Robert R. Alfano, George Eichmann, Roger Dorsinville, and Yao Li 5 Oct. 1987 9 p
(Grant AF AFOSR-0144-84)
(AD-A188279; RF-447211; AFOSR-87-1616TR) Avail: NTIS HC A02/MF A01 CSCL 20F

Fundamental optical nonlinear processes based on x(2) and x(3) in different materials (liquids, polymers, and semiconductors) were investigated for size and speed. Ultrafast optical logic devices, switches, and processes based on these nonlinear optical materials were designed, built, and tested. Twenty one papers were published during this work in the period 1986 to 1987. GRA

75 PLASMA PHYSICS

Includes magnetohydrodynamics and plasma fusion.

For ionospheric plasmas see *46 Geophysics*. For space plasmas see *90 Astrophysics*.

N88-18412# Gosudarstvennyi Komitet po Ispolzovaniyu Atomnoi Energii, Moscow (USSR). Inst. Atomnoj Ehnergii.
TOKAMAK WITH HIGHLY ELONGATED CROSS-SECTION OF A PLASMA
N. N. Brevnov, Yu. V. Gribov, V. E. Zhogolev, I. O. Pogutse, S. V. Putvinskij, and M. B. Strizhanova 1986 15 p In RUSSIAN
(DE88-700356; IAE-4333/7) Avail: NTIS (US Sales Only) HC A03/MF A01

Problems related to the formation and control of the equilibrium of the filament with a highly elongated cross section K less than or equal to 4, where K is the relation of semiaxes, are considered. Calculations of equilibrium, stability and evolution of plasma parameters are performed to develop poloidal field systems and choice of the optimal scenario of the discharge. A round filament is supposed to form at the initial stage, and then to elongate its cross section up to K=4 due to the operation of the poloidal field system. The results of calculation of plasma equilibrium are given; currents in poloidal coils necessary to provide series of equilibria with subsequent increasing elongation of the cross section are found. Stability of the highly elongated filament is discussed; the position of windings of passive stabilization is calculated. The results of calculation of evolution of plasma parameter profiles in the process of formation of the elongated cross section. The calculations allow the chose of proper period to this process. The following conclusions are made: to provide the filament equilibrium with cross section elongation up to K=4, the poloidal field system should be supplied with additional windings; the total current in these windings is to be not less than 100 kA, i.e., approx. 40 percent of the plasma current; the poloidal field system is to be supplied with the automatic control system. DOE

N88-18413# Naval Research Lab., Washington, D.C.
CORONAL HEATING BY MEANS OF HELICAL MAGNETO-HYDRODYNAMIC TURBULENCE
R. B. Dahlburg, J. P. Dahlburg, and J. T. Mariska 17 Dec. 1987 43 p
(AD-A187084; NRL-MR-6073) Avail: NTIS HC A03/MF A01 CSCL 20I

Numerical simulations are used to investigate the relaxation of an unconfined, helically turbulent, fully three-dimensional magnetofluid, with conditions similar to those which are thought to result in the heating of the solar corona. In these simulations, the system evolves through a succession of force free states. After a relatively quiescent period of Ohmic decay, a phase of accelerated magnetic energy dissipation occurs. Some magnetic energy is transformed into kinetic energy, and the magnitude of entrophy created is a nontrival fraction of the mean square electric current. Concentrated vorticity structures are seen to play almost as important a role as electric current sheets in the heating process. Coincident with this accelerated dissipation process, a reorganization of the magnetic fields occurs, with transfer of magnetic energy to both shorter and longer wavelength modes than are initially present. The ratio of the magnetic field to the electric current density, alpha does not in general tend to assume a constant value in the force free regions during the evolution of the magnetofluid. GRA

N88-18414# Royal Inst. of Tech., Stockholm (Sweden). Dept. of Plasma Physics.
ON THE ROLE OF THE IONIZATION FREQUENCY TO GYROFREQUENCY RATIO IN THE CRITICAL IONIZATION VELOCITY INTERACTION
Nils Brenning Oct. 1986 28 p
(TRITA-EPP-86-10; ISSN-0348-7539; ETN-88-91677) Avail: NTIS HC A03/MF A01

The role of the parameter vi sup omega sup ci for critical ionization velocity (CIV) interaction is discussed. This parameter, which can be seen as a combined condition on the neutral gas density and the magnetic field strength, is important from two different aspects. The value vi sup omega sup ci = 1 marks the limit between the regions of applicability of the homogeneous and the ionizing front (or inhomogeneous) models for the interaction. It determines the energy transfer efficiency in the interaction. This energy transfer efficiency also depends strongly on whether the experiment is steady-state or transient. In steady-state situations, the interaction becomes gradually weaker when vi sup omega sup ci decreases below unity. It is found that efficient CIV interaction is possible at far lower values of vi sup omega sup ci in transient experiments. The corresponding limit is vi sup omega sup ci = 2(me/mi) sup 3/2 k cubed. Unfortunately, k is a rather uncertain parameter: the number of instability growth times required for the modified two-stream instability to tap the energy of a thin ion stream in a plasma. ESA

N88-18415# Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of Nuclear Problems.
OPTIMIZATION OF OUTLET CHANNEL OF PLASMA ION SOURCE
K. Kiszczak, A. Lyatushinski, D. Monchka, and Yu. V. Yushkevich 1986 6 p In RUSSIAN
(DE88-700471; JINR-13-86-736) Avail: NTIS (US Sales Only) HC A02/MF A01

Design and operation principle of arc hollow-cathode ion source are presented. The effect of source outlet length on emitted ion current and ionization efficiency have been investigated by means

of this source. Empirical formula for calculating the source ionization efficiency has been derived, and some of its characteristics are presented. The noticeable effect of emission channel geometry on ion currents of the source and efficiency of using working substance is shown. DOE

N88-18416# Japan Atomic Energy Research Inst., Tokyo.
PLASMA PHYSICS DESIGN AND MAJOR SPECIFICATIONS OF CANDIDATE REACTORS FOR FER DESIGN STUDIES. CONCEPTUAL DESIGN STUDY OF FY86 FER
Masayoshi Sugihara, Tadanori Mizoguchi, and Akiyoshi Hatayama Aug. 1987 54 p In JAPANESE
(DE88-751066; JAERI-M-87-108) Avail: NTIS (US Sales Only) HC A04/MF A01

Physics design and reference options of FER (Fusion Experimental Reactor) for FY86 conceptual design study are presented. As for physics design, emphases are placed on the data base, from which physics design constraints different from those of FY84 and 85, have been derived. Wide parametric studies are done for the cost-effectiveness to select the reference options. They are reduction of volt center dot second, noncircularity, shield thickness, magnet design constraints, partial usage of normal conducting OH coils, and impact of the access method to the reactor core component on the capacity of PF coil system. Based on these studies, various system quantities are evaluated and five reference options are selected. DOE

N88-18417# Japan Atomic Energy Research Inst., Tokyo.
DEVELOPMENT OF TOKAMAK REACTOR SYSTEM ANALYSIS CODE NEW-TORSAC
Masao Kasai, Toshio Ida, Masana Nishikawa, Akihisa Kameari, Satoshi Nishio, and Tatsuzo Tone Jul. 1987 38 p
(DE88-751067; JAERI-M-87-103) Avail: NTIS (US Sales Only) HC A03/MF A01

A systems analysis code named NEW-TORSAC (TOkamak Reactor Systems Analysis Code) has been developed by modifying the TORSAC which had been already developed by us. The NEW-TORSAC is available for tokamak reactor designs and evaluations from experimental machines to commercial reactor plants. It has functions to design tokamaks automatically from plasma parameter setting to determining configurations of reactor equipments and calculating main characteristics parameters of auxiliary systems and the capital costs. In the case of analyzing tokamak reactor plants, the code can calculate busbar energy costs. In addition to numerical output, some output of this code such as a reactor configuration, plasma equilibrium, electro-magnetic forces, etc., are graphically displayed. The code has been successfully applied to the scoping studies of the next generation machines and commercial reactor plants. DOE

N88-18418# Japan Atomic Energy Research Inst., Tokyo.
CONCEPTUAL DESIGN STUDY OF FUSION EXPERIMENTAL REACTOR (FY86 FER): SAFETY
Yasushi Seki, Hiromasa Iida, and Tsutomu Honda Aug. 1987 240 p In JAPANESE
(DE88-751071; JAERI-M-87-111) Avail: NTIS (US Sales Only) HC A11/MF A01

This report describes the study on safety for FER (Fusion Experimental Reactor) which has been designed as a next step machine to the JT-60. Though the final purpose of this study is to have an image of design base accident, maximum credible accident and to assess their risk or probability, etc., as FER plant system, the emphasis of this years study is placed on fuel-gas circulation system where the tritium inventory is maximum. The report consists of two chapters. The first chapter summarizes the FER system and describes FMEA (Failure Mode and Effect Analysis) and related accident progression sequence for FER plant system as a whole. The second chapter of this report is focused on fuel-gas circulation system including purification, isotope separation and storage. Probability of risk is assessed by the probabilistic risk analysis (PRA) procedure based on FMEA, ETA and FTA. DOE

N88-18419# Nagoya Univ. (Japan). Inst. of Plasma Physics.
D-3He FUELS IN A FIELD-REVERSED CONFIGURATION
Hiromu Momota, Masao Okamoto, Yasuyuki Nomura, Masami Ohnishi, Herbert L. Berk, and Toshiki Tajima (Texas Univ., Austin.) Nov. 1987 29 p
(IPPJ-855; ISSN-0469-4732) Avail: NTIS HC A03/MF A01

Favorable features of the D-He(3) fuel cycle in a field-reversed configuration are described. Based on a theoretical analysis, it was found that the estimated plant efficiency is more than 70 percent and the 14 MeV neutron power fraction is as small as 1 percent. To reach the D-He(3) initiation temperature of 100 keV with a reasonable external power source, a D-T configuration can first be ignited and then the fuel altered to D-3He. Heating of the plasma is attributed to energetic fusion charged particles and no additional heating is necessary. The equilibria of D-3He ignited plasmas may be self-sustained due to the preferential trapping of fusion protons in a field-reversed configuration. Author

N88-18420# Nagoya Univ. (Japan). Inst. of Plasma Physics.
NEW MODE CONVERSION PROCESS AND OVERDENSE PLASMA HEATING IN THE ELECTRON CYCLOTRON RANGE OF FREQUENCIES
S. Nakajima and H. Abe Nov. 1987 16 p
(IPPJ-854; ISSN-0469-4732) Avail: NTIS HC A03/MF A01

Through a particle-simulation investigation, a new mode conversion process, through which an incident fast extraordinary mode (fast X mode) is converted into an electron Bernstein mode (B mode) via a slow extraordinary mode (slow X mode), is discovered in plasmas whose maximum density exceeds the cutoff density of the slow X mode. The converted B mode is found to heat the electrons efficiently in an overdense-plasma region, when a plasma has the optimum density gradient at the plasma surface. Author

N88-18421 California Univ., Los Angeles.
INVESTIGATIONS OF STIMULATED RAMAN SCATTERING FROM HIGH DENSITY UNDERDENSE PLASMAS IRRADIATED BY A 0.35 MICRON LASER Ph.D. Thesis
Humberto Glodulfo T. FigueroaLopez 1986 145 p
Avail: Univ. Microfilms Order No. DA8723164

Studies of stimulated Raman back and forward scattering and the generation of high energy electrons at 0.35 microns are presented. To isolate the various phenomena occurring at different densities, researchers attempted to control the plasma density by varying the thickness of the foil targets and also by using foam targets of variable average density. The frequency of the scattered light is used as a diagnostic to measure the plasma density. Time resolved and time integrated spectra for various plasma densities are discussed. Also, the measured energy and angular distribution of the high energy electrons from foil targets are presented. Two-plasmon decay is suggested as the probable mechanism generating the hot electrons. Dissert. Abstr.

N88-18422 Illinois Univ. at Urbana-Champaign, Savoy.
APPLICATIONS OF LIE GROUP METHODS TO THE EQUATIONS OF MAGNETOHYDRODYNAMICS Ph.D. Thesis
John Mandrekas 1987 214 p
Avail: Univ. Microfilms Order No. DA8721704

The invariance properties of various sets of magnetohydrodynamic (MHD) equations are studied using techniques from the theory of differential forms. Equations considered include the ideal MHD equations in different geometries and with different magnetic field configurations, the MHD equations in the presence of gravitational forces due to self-attraction or external fields, the MHD equations including finite thermal conductivity and magnetic viscosity. The knowledge of the group structure of these equations is then used to introduce similarity variables to these equations. For each choice of similarity variables, the original set of partial differential equations is transformed into a set of ordinary differential equations and the most general form of the initial conditions is determined. Three cases are studied in detail and the corresponding sets of ordinary differential equations are solved numerically. Dissert. Abstr.

N88-18423# Stanford Linear Accelerator Center, Calif.
THE NUMERICAL SIMULATION OF ACCELERATOR COMPONENTS
W. B. Herrmannsfeldt and H. Hanerfeld May 1987 26 p Presented at the IEEE Minicourse on Computer Application in Plasma Science, Washington, D.C., 3 Jun. 1987
(Contract DE-AC03-76SF-00515)
(DE87-011597; SU-SLAC-PUB-4335; CONF-8706238-1) Avail: NTIS HC A03/MF A01

The techniques of the numerical simulation of plasmas can be readily applied to problems in accelerator physics. Because the problems usually involve a single component plasma, and times that are at most, a few plasma oscillation periods, it is frequently possible to make very good simulations with relatively modest computation resources. We will discuss the methods and illustrate them with several examples. One of the more powerful techniques of understanding the motion of charged particles is to view computer-generated motion pictures. We will show several little movie strips to illustrate the discussions. The examples will be drawn from the application areas of Heavy Ion Fusion, electron-positron linear colliders and injectors for free-electron lasers. DOE

N88-18424# Oak Ridge National Lab., Tenn.
EVALUATION OF MAGNETIC COORDINATES IN FINITE-BETA, ASYMMETRIC PLASMAS
C. O. Beasley, J. A. Rome, S. E. Attenberger, and S. P. Hirshman Nov. 1987 23 p
(Contract DE-AC05-84OR-21400)
(DE88-003665; ORNL/TM-10222) Avail: NTIS HC A03/MF A01

Analytical and numerical stability or transport calculations for toroidal plasmas are facilitated by using flux coordinates in which the magnetic field lines are straight. A published method for obtaining these magnetic coordinates, or more specifically the Fourier components of the magnetic field in this coordinate system, has existed for a vacuum magnetic field. A procedure for calculating these components for a finite- beta plasma equilibrium, however, has not previously been available, (here, beta is the ratio of plasma pressure to magnetic pressure). In this report, we describe such a procedure, in which we start with an arbitrary-beta magnetic equilibrium for which nested toroidal flux surfaces exist and obtain the Fourier components of the magnetic field in straight-line magnetic coordinates. We describe the various numerical procedures, referring to published documentation where needed. We then document the codes involved and apply them to a specific toroidally nonsymmetric, finite-beta plasma. DOE

N88-18425# California Univ., Berkeley.
PLASMA CONFINEMENT CALCULATIONS FOR TIBER-2 Final Report
E. Ibrahim 14 Oct. 1987 31 p
(Contract W-7405-eng-48)
(DE88-004044; UCRL-15979) Avail: NTIS HC A03/MF A01

This paper compares the empirically based TIBER-2 design parameters against the reactor parameters of a tokamak based on a theoretical model of heat transport. The motivation behind this project is the following. The present TIBER-2 design is based on an empirical scaling of confinement time tau/sub E/ known as Kaye-Goldston scaling. This empirical scaling is based on data from tokamak plasmas whose temperatures did not exceed a few keV, while the TIBER-2 requires electron temperatures of 25 keV. The question, then, is whether the Kaye Goldston scaling is valid at temperatures above the range of empirical data. For this we must turn to theory. If a theoretical transport model is available that shows favorable correlation with the Kaye-Goldston scaling in the range of a few keV, then this scaling could be extrapolated to the 25 keV range required for TIBER-2. The project is divided into two parts. Part one of the project concerns the development of a transport model from plasma theory that has empirical support. Part two of the project consists of applying the transport model to the TIBER-2 design. DOE

N88-18426# Gosudarstvennyi Komitet po Ispolzovaniyu Atomnoi Energii, Moscow (USSR). Inst. Teoreticheskoj i Ehksperimental'noj Fiziki.
SELF-SIMILAR SOLUTIONS OF MHD EQUATIONS OF PLASMA FILAMENT IN THE CASE OF COMPLETE DEGENERATED ULTRARELATIVISTIC ELECTRON GAS
S. T. Sukhorukov 1986 8 p In RUSSIAN
(DE88-700684; ITEF-105(1986)) Avail: NTIS (US Sales Only) HC A02/MF A01

The self-similar solution of one-liquid MHD equations of perfectly conducting plasma filament describing adiabatic nonlinear pulsations of the plasma filament with current in case of complete degenerated ultrarelativistic electron gas has been found. DOE

N88-18427*# Alabama Univ., Huntsville.
A STUDY OF SINGLE AND BINARY ION PLASMA EXPANSION INTO LABORATORY-GENERATED PLASMA WAKES
Kenneth Herbert Wright, Jr. Washington NASA Feb. 1988 186 p
(Contract NAS8-31088; Grant NAG8-058)
(NASA-CR-4125; NAS 1.26:4125) Avail: NTIS HC A09/MF A01 CSCL 20I

Plasma expansion into the wake of a large rectangular plate immersed in a collisionless, supersonic plasma was investigated in laboratory experiments. The experimental conditions address both single ion and binary ion plasma flows for the case of a body whose size is large in comparison with the Debye length, when the potential difference between the body and the plasma is relatively small. A new plasma source was developed to generate equi-velocity, binary ion plasma flows, which allows access to new parameter space that have previously been unavailable for laboratory studies. Specifically, the new parameters are the ionic mass ratio and the ionic component density ratio. In a series of experiments, a krypton-neon plasma is employed where the ambient density ratio of neon to krypton is varied more than an order of magnitude. The expansion in both the single ion and binary ion plasma cases is limited to early times, i.e., a few ion plasma periods, by the combination of plasma density, plasma drift speed, and vacuum chamber size, which prevented detailed comparison with self-similar theory. Author

N88-18428# Oak Ridge National Lab., Tenn.
BENCHMARKS OF NEUTRAL BEAM INJECTION CODES FOR STELLARATORS
R. H. Fowler, J. A. Rome, R. N. Morris, and K. Hanatani 1987 40 p Presented at the US/Japan Heliotron-stellarator Workshop, Oak Ridge, Tenn., 9 Nov. 1987 Prepared in cooperation with Kyoto Univ., Uji, Japan
(Contract DE-AC05-84OR-21400)
(DE88-003786; CONF-871179-9) Avail: NTIS HC A03/MF A01

The 3-dimensional geometry of stellarators/heliotrons make it more difficult to calculate beam deposition and thermalization. Extensive comparisons between the Oak Ridge and Kyoto codes were undertaken, using a simplified model for the Heliotron-E plasma and magnetic field. The perpendicular injection geometry causes most of the energetic fast ions to be helically trapped. The high transform and shear of the heliotron configuration helps to confine these orbits, but energy losses in the model cases ranged from 20 to 50 percent. Although the codes use different coordinate systems and collision operators, when they solve the same problem, the answers are equivalent. For perpendicular injection, very little, if any, acceleration of the slowing process can be tolerated. DOE

N88-18429# KMS Fusion, Inc., Ann Arbor, Mich.
THE DEPOSITION RATE DEPENDENCE OF PLASMA POLYMERIZATION ON THE RADIUS OF CURVATURE OF THE SUBSTRATE
H. K. Lintz, S. R. Murrell, R. L. Crawley, and J. C. Daukas 1987 15 p Presented at the 34th National Vacuum Symposium and Topical Conference, Anaheim, Calif., 2 Nov. 1987
(Contract DE-AC08-87DP-10560)

(DE88-003811; KMSF-U-1877; CONF-871125-16) Avail: NTIS HC A03/MF A01

In the plasma polymerization deposition of CH/sub x/ onto microspherical Inertial Fusion targets we have found that the coating rate varies with substrate diameter. Spherical shells ranging in diameter from 100 to 1000 microns were coated with several microns of plasma polymerized trans-2-butene under identical conditions and their coating thicknesses measured interferometrically. We found that the coating rate variation with shell radius could be described by an equation having the form $dr/dt = A/(R + r) + B$ where dr/dt is the coating rate, R the initial sphere radius, r the coating thickness, and A and B parameters related to the plasma conditions. We also found that there exists a functional relationship between the parameters A and B which is dependent on the RF power density. A model has been developed to show how this observed rate dependence relates to the buildup of an electrical charge on the nonconducting substrate surface. The electric field which arises is dependent on the radius of curvature of the substrate and in turn affects the contribution to the film growth by the ionized species impinging upon the surface. Neutral species arriving at the surface are not affected and thus lead to the B term in the empirical form of the rate dependence. DOE

N88-18430# Lawrence Livermore National Lab., Calif.
FIRST AND SECOND HARMONIC ECRH EXPERIENCE AT GYROTRON FREQUENCIES AT LLNL
B. Stallard Nov. 1987 20 p Presented at the International Conference on ECR Ion Sources and their Applications, East Lansing, Mich., 16 Nov. 1987
(Contract W-7405-eng-48)
(DE88-003998; UCRL-97660; CONF-8711107-3) Avail: NTIS HC A03/MF A01

Plasma heating of electrons in both mirror machines and tokamaks, using mm wave gyrotron sources, have been carried out in many experiments in recent years. The technology for both sources and mode-preserving waveguide transmission systems is well developed at power levels of 200 kW. At LLNL electron heating at 28 GHz in the TMX-U tandem mirror has been used to create hot electrons required for a thermal barrier (potential well). TMX-U, and other devices operating at lower frequency and power (10 GHz, few kW), routinely generates electron populations with mean energies of 100 to 500 keV and densities in the low to mid 10 to the 11th power/cu cm range. Radial pressure profiles vary from peaked-on-axis to hollow and are dependent on the mod-B resonance surfaces. Experiments on the axisymmetric mirror SM-1 have shown improved heating efficiency using multiple frequencies with narrow frequency separation. The importance of RF diffusion in determining electron confinement has been shown in CONSTANCE B. Fokker-Planck and particle orbit models have been useful for understanding the importance of cavity heating for creating runaway electrons, the sensitivity of hot electron production to cold plasma, the reduction of electron lifetime by RF diffusion, and the effect of multiple frequencies on heating stochasticity. Potential wells generated in plasmas with large fractions of mirror-trapped electrons have been measured in TMX-U. These offer prospects for enhanced confinement of highly stripped ions. DOE

N88-18431# Wisconsin Univ., Madison. Dept. of Physics.
STABILITY OF AN RFP (REVERSED-FIELD PINCH) WITH RESISTIVE AND DISTANT BOUNDARIES
Y. L. Ho and S. C. Prager Nov. 1987 39 p
(Contract DE-FG02-85ER-53212)
(DE88-004155; DOE/ER-53212/115) Avail: NTIS HC A03/MF A01

The linear MHD stability of current-driven modes is evaluated for a reversed field pinch in which the plasma is bounded by a thin resistive shell which is surrounded by a vacuum region out to a radius at which a perfectly conducting wall is situated. The effects of variation of the shell resistivity and wall proximity are investigated. Growth rates of tearing modes and kink modes are calculated by analytical solution based on the modified Bessel function model for the equilibrium. Relevence to experiments is discussed. DOE

N88-18432# Lawrence Livermore National Lab., Calif.
UNDERSTANDING AND ACCEPTING FUSION AS AN ALTERNATIVE ENERGY SOURCE
D. A. Goerz 10 Dec. 1987 15 p Presented at the 8th Miami International Conference on Alternative Energy Sources, Miami Beach, Fla., 14 Dec. 1987
(Contract W-7405-eng-48)
(DE88-004356; UCRL-96657; CONF-871204-2) Avail: NTIS HC A03/MF A01

Fusion, the process that powers our Sun, has long promised to be a virtually inexhaustible source of energy for mankind. No other alternative energy source holds such bright promise, and none has ever presentd such formidable scientific and engineering challenges. Serious research efforts have continued for over 30 years in an attempt to harness and control fusion here on Earth. Scientists have made considerable progress in the last decade toward achieving the conditions required for fusion power, and recent experimental results and technological progress have made the scientific feasibility of fusion a virtual certainty. With this knowledge and confidence, the emphasis can now shift toward developing power plants that are practical and economical. Although the necessary technology is not in hand today, the extension to an energy producing system in 20 years is just as attainable as was putting a man on the Moon. In the next few decades, the world's population will likely double while the demand for energy will nearly quadruple. Realistic projections show that within the next generation a significant fraction of our electric power must come from alternative energy sources. Increasing environmental concerns may further accelerate this timetable in which new energy sources must be introduced. The continued development of fusion systems to help meet the energy needs of the future will require greater public understanding and support of this technology. The fusion community must do more to make the public aware of the fact that energy is a critical international issue and that fusion is a viable and necessary energy technology that will be safe and economical. DOE

N88-18433# Lawrence Livermore National Lab., Calif.
HIGH Z INTERACTION PHYSICS ON NOVA
D. R. Kania, J. Albritton, B. Hatcher, R. Kauffman, H. Kornblum, S. Langer, B. Lasinski, G. Glendinning, D. Phillion, and L. Suter Aug. 1987 13 p Presented at the 31st SPIE Annual International Technical Symposium on Optical and Optoelectronic Applied Science and Engineering, San Diego, Calif., 16 Aug. 1987
(Contract W-7405-eng-48)
(DE88-004397; UCRL-97492; CONF-8708110-30) Avail: NTIS HC A03/MF A01

A detailed understanding of the interaction of laser light with high Z materials is important for the development of indirect drive inertial confinement fusion. To improve our understanding of the interaction of 0.35 micron light at intensities between 10 to the 14th power and 10 to the 15th power W/sq cm with high Z materials, we have performed a variety of experiments to address important physics issues. Hydrodynamics and ablation, transport processes, and X-ray conversion have been studied with thin Au dot targets and Au and Be mixture targets. DOE

N88-18434# Lawrence Livermore National Lab., Calif.
DESIGN ISSUES FOR A LABORATORY HIGH GAIN FUSION FACILITY
W. J. Hogan 2 Nov. 1987 5 p Presented at the 12th Symposium on Fusion Engineering, Monterey, Calif., 12 Oct. 1987
(Contract W-7405-eng-48)
(DE88-004406; UCRL-96710; CONF-871007-78) Avail: NTIS HC A02/MF A01

In an inertial fusion laboratory high gain facility, experiments will be carried out with up to 1000 MJ of thermonuclear yield. The experiment area of such a facility will include many systems and structures that will have to operate successfully in the difficult environment created by the sudden large energy release. This

paper estimates many of the nuclear effects that will occur, discusses the implied design issues and suggests possible solutions so that a useful experimental facility can be built. DOE

N88-18435# Lawrence Livermore National Lab., Calif.
THE STABILITY OF FREE-ELECTRON LASERS AGAINST FILAMENTATION
J. J. Barnard, E. T. Scharlemann, and S. S. Yu 15 Sep. 1987 15 p Presented at the 9th International Free Electron Laser Conference, Williamsburg, Va., 14 Sep. 1987
(Contract W-7405-eng-48)
(DE88-004712; UCRL-96821; CONF-8709140-2) Avail: NTIS HC A03/MF A01

In inertial confinement fusion (ICF) experiments, the high electromagnetic fields propagating through a relatively dense plasma can result in a transverse instability, causing the matter and light to form filaments oriented parallel to the light beam. We examine whether a similar instability exists in the electron beam of a free-electron laser, where such an instability could interfere with the transfer of beam kinetic energy into optical wave energy. We heuristically examine the instability in a relativistic beam through which an intense laser beam is propagating. We ignore the FEL effects. We estimate how the altered index of refraction in an FEL affects the dispersion relation. Finally, we estimate the effect that the instability could have on the phase coherence of a particle as it transits an FEL. DOE

N88-18436# Oak Ridge National Lab., Tenn.
ASYMMETRIC DOUBLE LANGMUIR PROBE FOR FAST AND AUTOMATIC MEASUREMENTS OF PLASMA TEMPERATURE
T. Uckan Nov. 1987 14 p
(Contract DE-AC05-84OR-21400)
(DE88-004773; ORNL/TM-10436) Avail: NTIS HC A03/MF A01

We present a fast technique for determining the plasma electron temperature T/sub e/ automatically from the small signal application of the asymmetric double Langmuir probe when it is operated in the region where -1 is less than eV/sub a/T/sub e/ is less than 1. The method described here is based on simple time and rms averages of the probe current that results from a sinusoidally varying applied voltage V/sub a/. DOE

N88-18437# California Univ., Berkeley. Electronics Research Lab.
[PLASMA THEORY AND SIMULATION] Progress Reports No. 3 and No. 4, 1 Jul. - 31 Dec. 1986
C. K. Birdsall 1987 43 p
(Contract DE-FG03-86ER-53220)
(DE88-003620; DOE/ER-53220/T3) Avail: NTIS HC A03/MF A01

Our group uses theory and simulation as tools in order to increase the understanding of plasma instabilities, heating, transport, plasma-wall interactions, and large potentials in plasmas. We also work on the improvement of simulation both theoretically and practically. DOE

N88-18438# Oak Ridge National Lab., Tenn.
DIAGNOSTICS FOR ATF
R. C. Isler 1987 39 p Presented at the US/Japan Heliotron-stellarator Workshop, Oak Ridge, Tenn., 9 Nov. 1987
(Contract DE-AC05-84OR-21400)
(DE88-004175; CONF-871179-3-Vugraphs) Avail: NTIS HC A03/MF A01

This paper contains viewgraphs on diagnostic instruments used in toroidal plasmas. The primary instruments covered are Langmuir probe, bolometers, infrared interferometer, spectrometers, Thomson scattering systems, neutral particle analyzers and infrared cameras. DOE

N88-18439# Oak Ridge National Lab., Tenn.
ATF EXPERIMENTAL PLANS
M. Murakami 10 Nov. 1987 28 p Presented at the US/Japan Heliotron-stellarator Workshop, Oak Ridge, Tenn., 9 Nov. 1987
(Contract DE-AC05-84OR-21400)
(DE88-004177; CONF-871179-2-Vugraphs) Avail: NTIS HC A03/MF A01

The Program is directed at better understanding and improvement of toroidal confinement through studies of: Beta limit; 2nd stability region; low nu* transport; role of E-field; effects of magnetic configurations (externally controlled) on Beta and transport; and issues critical to steady state operation (energy and particle handling, ICRF). DOE

N88-18440# Oak Ridge National Lab., Tenn.
SUPPRESSION OF X-RAYS GENERATED BY RUNAWAY ELECTRONS IN ATF
D. A. Rasmussen, A. C. England, C. C. Eberle, W. R. Devan, J. H. Harris, T. C. Jernigan, R. R. Kindsfather, R. N. Morris, M. Murakami, and G. H. Neilson 1987 24 p Presented at the US/Japan Heliotron-Stellarator Workshop, Oak Ridge, Tenn., 9 Nov. 1987 Prepared in cooperation with Kyoto Univ., Japan
(Contract DE-AC05-84OR-21400)
(DE88-004179; CONF-871179-10-Vugraphs) Avail: NTIS HC A03/MF A01

X-ray emission from runaway electrons on ATF is a serious issue. Runaway suppression techniques used on Heliotron-E are not adequate for ATF. Three approaches have been developed to suppress runaway production. Monitoring devices have been installed in occupied areas and personnel access and exposure will be limited. Additional shielding will be added as required. These systems will be ready for installation and testing on ATF prior to commissioning or first plasma operation. DOE

N88-18441# Oak Ridge National Lab., Tenn.
STUDY OF RESISTIVE PRESSURE-GRADIENT-DRIVEN TURBULENCE
G. S. Lee, L. Garcia, B. A. Carreras, and P. H. Diamond 1987 24 p Presented at the Meeting of the Division of Plasma Physics of the American Physical Society, San Diego, Calif., 2 Nov. 1987 Prepared in cooperation with Texas Univ., Austin and Universidad Complutense de Madrid, Spain
(Contract DE-AC05-84OR-21400)
(DE88-005062; CONF-871105-4) Avail: NTIS HC A03/MF A01

Previous studies have shown that resistive pressure-gradient-driven turbulence (RPGDT) is a likely cause of observed turbulent fluctuations and anomalous transport in magnetically confined plasmas. More recent study of RPGDT found a true saturation criterion and predicted significantly larger pressure diffusivity over simple mixing-length estimate. In this study, we investigate wavenumber spectrum for more detailed characteristics of this driven turbulence and consider an electromagnetic model with electron temperature evolution to study the effect of magnetic fluctuations on thermal transport. DOE

N88-18442# Pennsylvania State Univ., University Park. Dept. of Nuclear Engineering.
ZERO-DIMENSIONAL MODEL OF A REVERSED FIELD PINCH FUSION REACTOR Ph.D. Thesis
R. Veerasingam Dec. 1987 118 p
(Contract DE-FG02-87ER-53252)
(DE88-005213; DOE/ER-53252/4) Avail: NTIS HC A06/MF A01

A zero-dimensional model for the energy balance for electrons and ions of a Reversed Field Pinch (RFP) device has been developed. The model can be used as a tool for parametric studies and has been applied to simulate some ZT-40M experiments. In the model multiplicative coefficients C1, C2, C3 and C4 are introduced to treat anomalous resistivity, electron and ion energy confinement times and to account for the instability driven ion heating that is observed in RFP experiments. Parametric studies were performed to determine the sensitivity of the model to changes in multiplicative coefficients. A set of coefficients which can simulate a number of ZT-40M experiments have been obtained and the sensitivity of T(sub e) and T(sub i) to these coefficients was examined. Both flat top and ramp current waveforms were studied. The effects of different levels of impurities were also examined.

The results showed that while all the three impurities used, viz., carbon, oxygen and nickel contributed to Z(sub eff), nickel dominated the impurity radiation power. The results were then applied to the behavior of the ZT-H device which is being built in the Confinement Physics Research Facility at the Los Alamos National Laboratory. DOE

N88-18443*# National Aeronautics and Space Administration. Langley Research Center, Hampton, Va.
LASER PRODUCTION AND HEATING OF PLASMA FOR MHD APPLICATION
N. W. Jalufka Mar. 1988 11 p
(NASA-TP-2798; L-16373; NAS 1.60:2798) Avail: NTIS HC A03/MF A01 CSCL 20I

Experiments have been made on the production and heating of plasmas by the absorption of laser radiation. These experiments were performed to ascertain the feasibility of using laser-produced or laser-heated plasmas as the input for a magnetohydrodynamic (MHD) generator. Such a system would have a broad application as a laser-to-electricity energy converter for space power transmission. Experiments with a 100-J-pulsed CO2 laser were conducted to investigate the breakdown of argon gas by a high-intensity laser beam, the parameters (electron density and temperature) of the plasma produced, and the formation and propagation of laser-supported detonation (LSD) waves. Experiments were also carried out using a 1-J-pulsed CO2 laser to heat the plasma produced in a shock tube. The shock-tube hydrogen plasma reached electron densities of approximately 10 to the 17th/cu cm and electron temperatures of approximately 1 eV. Absorption of the CO2 laser beam by the plasma was measured, and up to approximately 100 percent absorption was observed. Measurements with a small MHD generator showed that the energy extraction efficiency could be very large with values up to 56 percent being measured. Author

76 SOLID-STATE PHYSICS

Includes superconductivity.

For related information, see also *33 Electronics and Electrical Engineering* and *36 Lasers and Masers.*

N88-18444# Cornell Univ., Ithaca, N.Y. School of Electrical Engineering.
MICROWAVE SEMICONDUCTOR RESEARCH-MATERIALS, DEVICES AND CIRCUITS Final Report, 1 May 1984 - 30 Apr. 1987
L. F. Eastman, J. R. Shealy, D. W. Woodard, S. Mukherjee, and G. W. Wicks Oct. 1987 53 p
(Contract F49620-84-C-0060)
(AD-A187121; AFOSR-87-1632TR) Avail: NTIS HC A04/MF A01 CSCL 20L

This program covers the growth and assessment of gallium arsenide and related compounds and alloys for use in microwave, millimeter wave, and optical devices. It also covers the processing of the material into devices, the testing of the devices, and the theoretical modeling of carrier transport in these devices. Both molecular beam epitaxy (MBE) and organometallic vapor phase epitaxy (OMVPE) are used for growth. The following specific tasks are pursued: develop an improved understanding of the role of the substrate and growth parameters on the quality of device structures on GaAs and related materials grown by OMVPE; investigate the frequency and power limits of power FET devices employing a two-dimensional electron gas in the channel; investigate and improve heterojunction structures for transistor applications; produce semiconductor light emitters capable of high speed amplitude modulation; femtosecond optical investigation of hot carrier dynamics in III-V compounds and quantum wells; develop high speed receivers for optical communication using optical field effect transistors and large area epitaxial photoconductive detectors; use optical excitation to study carrier dynamics in compound semiconductors; develop advanced design techniques for microwave GaAs FET amplifiers; improve direct method of broad band circuit design; and explore transient carrier transport in small III-V devices in boundary limited domain. GRA

N88-18445# Argonne National Lab., Ill.
SPIN DISORDER RESISTIVITY AND BARE CURIE TEMPERATURE IN THE FERROMAGNETIC SUPERCONDUCTOR ErRh4B4
W. K. Kwok, S. P. Middleton, L. N. Hall, B. D. Dunlap, W. Joss, G. W. Crabtree, and D. G. Hinks May 1987 3 p Presented at the 18th Conference on Low Temperature Physics, Kyoto, Japan, 20 Aug. 1987 Prepared in cooperation with Purdue Univ., Lafayette, Ind.; Hughes Telecommunications, El Segundo, Calif.; Max-Planck-Inst., Grenoble, France and Boeing Aerospace Co., Seattle, Wash.
(Contract W-31-109-eng-38)
(DE88-003016; CONF-870873-22) Avail: NTIS HC A02

Low temperature ac magnetoresistance measurements on a single crystal of ErRh sub 4 B sub 4 were made to determine the bare Curie temperature and the spin disorder resistivity. A crossed field technique was used to suppress the superconductivity in order to probe the normal state properties. The bare Curie temperature was found to be 1.07 K and the spin disorder resistivity extrapolates to a finite value at T = OK. DOE

N88-18446 Stanford Univ., Calif.
SPECIFIC HEAT OF NOVEL THIN-FILM MATERIAL SYSTEMS Ph.D. Thesis
David Mael 1987 81 p
Avail: Univ. Microfilms Order No. DA8723047

Specific heat measurements are presented of two new thin film material systems, which show that the thermodynamics of such systems can be well described using simple modified one electron models. First, a series of amorphous molybdenum based metal-metalloid alloys was studied. Absolute specific heat measurements of thin film samples were made using a relaxation time constant method. These show that the sample homogeneity is better then 0.1 percent for length scales greater than the coherence length. Both the electronic density of states and the transition temperature increased with increasing metalloid concentration. Detailed work through the metal insulator transition shows that there is a linear decrease of the electronic density of states and a monotonic decrease in the Debye temperature with decreasing metal concentration. Secondly, the first specific heat measurements of an artificially layered structure, namely a niobium zirconium metallic multilayer system, is presented. The effective Debye temperature and electronic density of states was obtained for the samples as well as the specific heat jump. These results show that the thermodynamic properties of the multilayered system vary as the bilayer thickness is increased. Dissert. Abstr.

N88-18447 Stanford Univ., Calif.
TIGHT BINDING THEORY OF SEMICONDUCTORS Ph.D. Thesis
Mark vanSchilfgaarde 1987 80 p
Avail: Univ. Microfilms Order No. DA8723109

An extension of Harrison's theory of the two-center bond to the multicenter bond is applied to Zn3P2 and elemental boron. The theory predicts experimentally measurable properties with essentially the same accuracy as Harrison's theory predicts properties of tetrahedrally coordinated semiconductors. The second chapter uses the experimental elastic constants as a vehicle to test various aspects of Harrison's theory. It is found that the two central premises of the theory, the universal matrix elements and the Bond Orbital Approximation, are both remarkably good approximations to more elaborate theories. Harrison's repulsive interaction V sub 0 that stabilizes the crystal at its equilibrium spacing was found to be missing a significant contribution, one arising from the orthogonalization of valence wave functions to neighboring cores. The contribution is of sufficient magnitude to account for the rather severe underestimate of the bulk modulus. In the third chapter, tight-binding theory is used as a framework to calculate the configuration dependence of the Coulomb electron-electron interaction in pseudobinary alloys of

semiconductors of the form A(0.5)B(0.5)C. It is found that there is a considerable configuration dependence of this interaction: random configurations have a higher internal energy than ordered ones. The Coulomb contribution to the mixing enthalpy is discussed, and is observed to be comparable to the strain contribution customarily considered. Dissert. Abstr.

N88-18448# Melbourne Univ., Parkville (Australia). Dept. of Physical Chemistry.
ELECTRON TRANSFER TO IRON(3) OXIDE COLLOIDS
P. Mulvaney, F. Grieser, V. Swayambunathan, and D. Meisel 1987 10 p Presented at the Conference on Photoelectrochemistry and Electrosynthesis on Semiconducting Materials, Honolulu, Hawaii, 18 Oct. 1987 Prepared in cooperation with Argonne National Lab., Ill.
(Contract W-31-109-eng-38)
(DE88-002885; CONF-8710229-1) Avail: NTIS HC A02/MF A01

The electron transfer reaction from viologen radicals to colloidal iron(III) oxide and oxyhydroxide particles was investigated by pulse and steady-state radiolysis techniques. The rate of electron injection to oxyhydroxide particles was clearly controlled by their surface charge and in the region near the isoelectric point, the electron transfer rate is slower than the diffusion-controlled rate by at least two orders of magnitude. Conductivity measurements clearly reveal the occurrence of protonation reactions immediately following the initial electron transfer step. On the basis of the experimentally measured ratio of protons consumed to electrons injected, a mechanistic pathway describing the sequence of protonation reactions is proposed. The competition between surface trapping of charge and the migration of charge into the interior of the particles and the factors controlling these two events are also discussed. DOE

N88-18449# Sandia National Labs., Albuquerque, N. Mex.
HIGH TEMPERATURE PROCESSING OF SUPERCONDUCTING Y1Ba2Cu3O6.9
D. S. Ginley, E. L. Venturini, J. F. Kwak, R. J. Baughman, and B. Morosin 1987 11 p Presented at the Symposium on High-temperature Materials Chemistry, Honolulu, Hawaii, 18 Oct. 1987
(Contract DE-AC04-76DP-00789)
(DE88-003002; SAND-87-2579C; CONF-8710216-2) Avail: NTIS HC A03/MF A01

The YBaCuO system has produced superconductors with T sub c over 90 K. Integral to the production of these materials are high temperature sintering and subsequent oxygen annealing processes. Results are presented directed toward optimizing these two process steps. Oxygen stabilized the YBa sub 2Cu sub 3 O sub 6.9 material against decompostition to temperatures near the melting point, allowing processing at higher temperatures, which produces significantly higher quality single phase material and somewhat improved grain to grain contacts. DOE

N88-18450# Argonne National Lab., Ill.
NORMAL AND SUPERCONDUCTING STATE PROPERTIES OF La2-xSr/SUB x/CuO4
W. K. Kwok, G. W. Crabtree, D. G. Hinks, and D. W. Capone May 1987 3 p Presented at the 18th Conference on Low Temperature Physics, Kyoto, Japan, 20 Aug. 1987
(Contract W-31109-eng-38)
(DE88-003013; CONF-870873-21) Avail: NTIS HC A02

The resistivity, magnetoresistance, superconducting transition temperature, and critical fields for La(2-x)Sr(x)CuO4 were measured as a function of x. We find systematic behavior in the transition temperatures and critical field slopes, but not in the resistivities. DOE

N88-18451# University of Northern Illinois, De Kalb.
SUPERCONDUCTING AND MAGNETIC PROPERTIES OF Fe-DOPED OXIDE SUPERCONDUCTORS
C. W. Kimball, J. L. Matykiewicz, J. Giapintzakis, A. E. Dwight, M. B. Brodsky, M. Slaski, B. D. Dunlap, and F. Y. Fradin Sep. 1987 9 p Presented at the 18th Conference on Superconductivity in Highly Correlated Fermion Systems, Sendai, Japan, 31 Aug. 1987 Prepared in cooperation with Argonne National Lab., Ill.
(Contract W-31109-eng-38)
(DE88-003024; CONF-870881-8) Avail: NTIS HC A02/MF A01

The superconducting and magnetic properties of the compounds La(1.85)Sr(0.15)Cu(1-x)Fw(x)O4 and YBa2(Cu(1-x)Fe(x)) with 0 is less than x is less than 0.1 are presented. The Fe substitution in the La-Sr compound rapidly depresses T(sub c), extrapolating to T(sub c) = 0 for x approx. 0.02. However, T(sub c) is depressed much less rapidly in the Y-Ba compound, extrapolating to 0 K for x approx. 0.12. Moessbauer spectroscopy and magnetic data have been obtained to give information on the magnetic and structural properties of these materials. The results are compared with those for other dopants, both magnetic and nonmagnetic, in the oxide superconductors. DOE

N88-18452# Argonne National Lab., Ill.
THE PHYSICS OF METALLIC SUPERLATTICES: AN EXPERIMENTAL POINT OF VIEW
I. K. Schuller Jul. 1987 33 p Presented at the NATO Advanced Study Institute on Physics, Fabrication, and Applications of Multilayered Structures, Ile de Bendor, France, 22 Jun. 1987
(Contract W-31109-eng-38)
(DE88-003080; CONF-8706237-2) Avail: NTIS HC A03/MF A01

Experimental and theoretical data on metallic superlattices are presented. Topics discussed include electrical resistivity, superconductivity, elasticity, magnetic properties, coupling, thin film, interfacial and proximity effects. DOE

N88-18453# Northwestern Univ., Evanston, Ill. Dept. of Physics and Astronomy.
ELECTRONIC STRUCTURE, CHARGE TRANSFER EXCITATIONS AND HIGH TEMPERATURE SUPERCONDUCTIVITY
A. J. Freeman, Jaejun Yu, S. Massidda, and D. D. Koelling Sep. 1987 16 p Presented at the 18th Conference on Superconductivity in Highly Correlated Fermion Systems, Sendai, Japan, 31 Aug. 1987 Prepared in cooperation with Argonne National Lab., Ill.
(Contract W-31109-eng-38)
(DE88-003096; CONF-870881-6) Avail: NTIS HC A03/MF A01

High precision local density electronic band structure results for (YBa2Cu3O7, YBa2Cu3O6, and GdBa2Cu3O7) lead to the possibly important role of charge transfer excitations as the mechanism of high T(sub c) superconductivity, and explain the coexistence of magnetism and superconductivity in the high T(sub c) rare-earth superconductors. DOE

N88-18454# Northeastern Univ., Boston, Mass. Dept. of Physics.
POSITRON-ANNIHILATION 2D-ACAR STUDIES OF DISORDERED AND DEFECTED ALLOYS
A. Bansil, R. Prasad, L. C. Smedskjaer, R. Benedek, and P. E. Mijnarends Sep. 1987 28 p Presented at the U.S.-Japan Seminar on Electronic Structure and Lattice Defects in Alloys, Honolulu, Hawaii, 4 May 1987 Prepared in cooperation with Argonne National Lab., Ill., Netherlands Energy Research Foundation, Petten
(Contract W-31109-eng-38)
(DE88-003118; CONF-8705226-1) Avail: NTIS HC A03/MF A01

Theoretical and experimental progess in connection with 2D-ACAR positron annihilation studies of ordered, disordered, and defected alloys is discussed. We present, in particular, some of the recent developments concerning the electronic structure of disordered alloys, and the work in the area of annihilation from positrons trapped at vacancy-type defects in metals and alloys. The electronic structure and properties of a number of compounds are also discussed briefly; we comment specifically on high T sub c ceramic superconductors, Heusler alloys, and transition-metal aluminides. DOE

N88-18455# Lawrence Livermore National Lab., Calif.
CORNER COMPENSATION STRUCTURES FOR (110) ORIENTED SILICON
D. R. Ciarlo Nov. 1987 9 p Presented at the Micro Robots and Teleoperators Workshop, Hyannis, Mass., 9 Nov. 1987
(Contract W-7405-eng-48)
(DE88-003300; UCRL-97277; CONF-8711113-1) Avail: NTIS HC A02/MF A01

The use of (110) oriented silicon wafers has been studied for the fabrication of microscale mechanisms such as cantilever beams and latching mechanisms. Using this orientation, cantilever beams can be fabricated such that they deflect in a parallel direction to the wafer surface. It might be possible to fabricate structures such as setback accelerometers and latching mechanisms with (110) silicon cantilevers. Corner compensation structures have been designed and fabricated for use with (110) oriented cantilever beams. DOE

N88-18456# Illinois Univ., Urbana. Center for Supercomputing Research and Development.
[PERFORMANCE AND EVALUATION AT THE CENTER FOR SUPERCOMPUTING RESEARCH AND DEVELOPMENT] Quarterly Report, 1987
Aug. 1987 23 p Sponsored in part by IBM Corp., Alliant Computer Systems, Apollo, Control Data, and Digital Equipment
(Contract DE-FG02-85ER-25001; Grants NSF DCR-84-10110; NSF DCR-84-06916; NSF DCR-85-00970; AF-AFOSR-85-0211)
(DE88-003563; DOE/ER-25001/T2; QR-2) Avail: NTIS HC A03/MF A01

This report summarizes the work done at the Center for Superconducting Research and Development in the following areas: hardware development, architecture research, operating system development, operating system research, Cedar FORTRAN, symbolic processing, compiler research, scientific workstation environment (FAUST), numerical library and applications. DOE

N88-18457# Gosudarstvennyi Komitet po Ispolzovaniyu Atomnoi Energii, Moscow (USSR). Inst. Atomnoj Ehnergii.
COMPARATIVE EVALUATION OF RESISTIVE AND INDUCTIVE TECHNIQUES FOR MEASURING TEMPERATURE OF SUPERCONDUCTING TRANSITION
G. V. Sotnikov 1986 13 p In RUSSIAN
(DE88-700603; IAE-4345/10) Avail: NTIS (US Sales Only) HC A03/MF A01

Behavior of the bound system consisting of a superconducting sample and measuring coil is analyzed in the process of sample transition from the normal state to superconducting one proceeding from general electrodynamics laws. Formally, such a process is shown to be described by appearance of imaginary induction. Analytical expressions for the amplitude and signal phase are obtained for the case of using a simple bridge circuit when measuring. The substantial factor determining the form of superconducting transition obtained in the experiment (at the given dependence of sample resistance on the temperature) is the ratio between the effective sample resistance in the normal state and its induction. DOE

N88-18458# Instituto de Fisica Teorica, Sao Paulo (Brazil).
QUALITATIVE METHODS IN NONHOMOGENEOUS COSMOLOGY
G. Francisco 1986 24 p
(DE88-700620; IFT-P-13/86) Avail: NTIS (US Sales Only) HC A03/MF A01

Methods of qualitative dynamical systems are introduced in the study of general gravitational fields near the initial singularity. Using a synchronous reference frame it is proved that any cosmological singularity in a globally hyperbolic spacetime contains in its neighborhood a region where the metric tensor is close to a generalized Kasner universe. Consequences of this result in the description of the behavior of Einstein's equations near the singularity are emphasized. DOE

N88-18459# Vibration Inst., Clarendon Hills, Ill.
THE SHOCK AND VIBRATION DIGEST, VOLUME 20, NO. 2 Monthly Report
Judith Nagle-Eshleman, ed. Feb. 1988 72 p
Avail: NTIS HC A04/MF A01

The main feature is a literature review on recent progress in the dynamic applications of piezoelectric crystals. Abstracts from the current shock and vibration literature are also presented. Finally, news from the field, book reviews, and a calendar of events are included. For individual titles, see N88-18460 through N88-18460.

N88-18460# Technical Univ. of Istanbul (Turkey).
RECENT PROGRESS IN THE DYNAMIC APPLICATIONS OF PIEZOELECTRIC CRYSTALS
M. C. Doekmeci *In* Vibration Inst., The Shock and Vibration Digest. Volume 20, No. 2 Feb. 1988 p 3-20 (For primary document see N88-18459 10-76)
Avail: NTIS HC A04/MF A01

This paper presents an updated review of the open literature concerned with the dynamic applications of piezoelectric crystals. Representative current literature as well as previously surveyed literature that pertains to recent applications are reviewed for waves and vibrations in piezoelectric one-dimensional and two-dimensional elements. Experimental work and some numerical methods are briefly discussed, and future research needs are indicated. An extensive bibliography is included. Author

N88-18461# Sandia National Labs., Albuquerque, N. Mex.
EFFECTS OF X IRRADIATION AND HIGH FIELD ELECTRON INJECTION ON THE ELECTRICAL PROPERTIES OF RAPID THERMAL OXIDES
W. K. Schubert and C. H. Seager 1987 3 p Presented at the Electrochemical Society Meeting, Atlanta, Ga., 15 May 1987
(Contract DE-AC04-76DP-00789)
(DE88-002642; SAND-87-2764C; CONF-8705223-1) Avail: NTIS HC A02/MF A01

Rapid thermal oxidation (RTO) is a promising tool for fabricating the thin gate oxides (5 to 15 nm) that will be needed in future submicron integrated circuits, because of its inherently superior time-temperature control when compared to conventional oxidation methods. It is important to demonstrate that RTO can be used without adversely affecting the radiation hardness or high field properties of the oxide. Beyond this demonstration, rapid thermal processing makes it possible to determine more precisely how the kinetics of oxidation and post oxidation annealing affect the device properties. Information of this type should prove useful in modeling relevant defect formation mechanisms. A part of a systematic study of the effects of rapid thermal processing on the radiation and high field response of thin oxides is presented.
Author

N88-18462*# National Aeronautics and Space Administration, Washington, D.C.
THE BAND SYSTEMS OF ALKALI VAPORS
W. Weizel and M. Kulp Feb. 1988 16 p Transl. into ENGLISH from Annalen der Physik (Fed. Republic of Germany), v. 4, no. 5, 1930 p 971-984 Transl. by Scientific Translation Service, Santa Barbara, Calif.
(Contract NASw-4307)
(NASA-TT-20206; NAS 1.77:20206) Avail: NTIS HC A03/MF A01 CSCL 20L

A number of band edges of the molecules, Na2, K2, NaK, NaCs, LiK, LiRb, LiCs, and NaRb are arranged in edge schemes. The vibrational quanta of the base terms and the upper terms can be approximately determined. Viewpoints are produced for interpreting electron terms. The terms Na2 are interpreted as terms of a photo-electron. Author

N88-18463# Sandia National Labs., Albuquerque, N. Mex.
GROWTH AND ELECTRONIC PROPERTIES OF STRAINED METAL OVERLAYERS
G. L. Kellogg and J. E. Houston 1987 4 p Presented at the

Basic Energy Sciences Review, Albuquerque, N. Mex., 17 Jun. 1987
(Contract DE-AC04-76DP-00789)
(DE87-010956; SAND-87-1437C; CONF-8706239-1) Avail: NTIS HC A02/MF A01

Very detailed information relating to the growth and electronic properties of strained-metal overlayers has been obtained for Cu/Ru, Ni/Ru, and Ni/W. We are now in the process of extending these studies to other systems to examine the systematics of these properties. We are also attempting to correlate these properties with the observed chemical and catalytic behavior of the bimetallic systems. DOE

N88-18464# Sandia National Labs., Albuquerque, N. Mex.
OPTICAL CHARACTERIZATION OF GaAs/SUB 1-x/Sb/SUB x/ AND GaAs/SUB 1-x/Sb/SUB x/GaAs STRAINED LAYER SUPERLATTICES
J. F. Klem, D. Huang, H. Morkoc, Y. E. Ihm, and N. Otsuka 1987 19 p Presented at the SPIE O-E Lase '88: Optoelectronics and Laser Applications in Science and Engineering, Los Angeles, Calif., 10 Jan. 1988 Prepared in cooperation with Illinois Univ., Urbana and Purdue Univ., Lafayette, Ind.
(Contract DE-AC04-76DP-00789)
(DE88-003393; SAND-87-2589C; CONF-880110-2) Avail: NTIS HC A03/MF A01

Molecular beam epitaxy has been used to grow both GaAs/sub 0.5/Sb/sub 0.5/ films lattice-matched to InP and GaAs/sub 1-x/Sb/sub x//GaAs strained layer superlattices on GaAs substrates. Films grown on InP substrates are of a composition inside the well-known solid-phase miscibility gap for this alloy. Because these films are metastable, they exhibit an unusual microstructure which includes both ordering and clustering effects. Nevertheless, we have obtained low-temperature photoluminescence linewidths of under 8 MeV. This represents the best linewidth for this material reported to data. Correlations between film microstructure and the optical quality of these alloys have been observed. DOE

N88-18465# Brookhaven National Lab., Upton, N. Y.
MAGNETIC RARE EARTH SUPERLATTICES
C. F. Majkrzak, D. Gibbs, P. Boeni, A. I. Goldman, J. Kwo, M. Hong, T. C. Hsieh, R. M. Fleming, D. B. McWhan, and Y. Yafet 1987 26 p Presented at the 32nd Conference on Magnetism and Magnetic Materials, Chicago, Ill., 9 Nov. 1987 Prepared in cooperation with Bell Telephone Labs., Murray Hill, N.M.; ORNL, Tenn., Riso National Lab., Roskilde, Denmark, Kernforschungsanlage, Juelich, Fed. Republic of Germany and Johns Hopkins Univ., Baltimore, Md.
(Contracts DE-AC02-76CH-00016; DE-AC05-84OR-21400)
(DE88-003483; BNL-40484; CONF-871126-9) Avail: NTIS HC A03/MF A01

The magnetic structures of several single-crystal, magnetic rare earth superlattice systems grown by molecular beam epitaxy are reviewed. In particular, the results of recent neutron diffraction investigations of long-range magnetic order in Gd/Y, Dy/Y, Gd/Dy and Ho/Y periodic superlattices are presented. In the Gd/Y system, an antiphase domain structure develops for certain Y layer spacings, whereas modified helical moment configurations are found to occur in the other systems, some of which are commensurate with the chemical superlattice wavelength. References are made to theoretical interaction mechanisms recently proposed to account for the magnetic states of these novel materials. DOE

N88-18466# Illinois Univ., Urbana. Center for Supercomputing Research and Development.
CENTER FOR SUPERCOMPUTING RESEARCH AND DEVELOPMENT Quarterly Report No. 1
Jun. 1987 27 p
(Contract DE-FG02-85ER-25001)
(DE88-003564; DOE/ER-25001/T1) Avail: NTIS HC A03/MF A01

This paper discusses progress on hardware and applications of superconducting design. The topic titles covered are: hardware development, architecture research, operating system research and development, Cedar FORTRAN, symbolic processing, compiler research, scientific workstation environment, and numerical library. DOE

N88-18467# California Univ., Berkeley. Lawrence Berkeley Lab.
SOLVING COMPLEX AND DISORDERED SURFACE STRUCTURES WITH ELECTRON DIFFRACTION
M. A. VanHove Oct. 1987 35 p Presented at the 8th International Summer Inst. in Surface Science, Milwaukee, Wis., 17 Aug. 1987
(Contract DE-AC03-76SF-00098)
(DE88-003863; LBL-23875; CONF-8708195-1) Avail: NTIS HC A03/MF A01

The past of surface structure determination with low-energy electron diffraction (LEED) will be briefly reviewed, setting the stage for a discussion of recent and future developments. The aim of these developments is to solve complex and disordered surface structures. Some efficient solutions to the theoretical and experimental problems will be presented. Since the theoretical problems dominate, the emphasis will be on theoretical approaches to the calculation of the multiple scattering of electrons through complex and disordered surfaces. DOE

N88-18468# California Univ., Berkeley. Lawrence Berkeley Lab.
THE STRUCTURE AND PROPERTIES OF TWIN BOUNDARIES IN SUPERCONDUCTING YBa2Cu3O7
H. W. Zandbergen, R. Gronsky, M. Y. Chu, L. C. DeJonghe, G. F. Holland, and A. Stacy Nov. 1987 11 p Presented at the Fall Meeting of the Materials Research Society, Boston, Mass., 30 Nov. 1987
(Contract DE-AC03-76SF-00098)
(DE88-003864; LBL-24139; CONF-871124-17) Avail: NTIS HC A03/MF A01

A relationship between preparation procedures, diamagnetic yield and twin densities in YBa2Cu3O7 has been established. Decreasing the calcination temperature causes an increase in the formation of /100/ 90 deg rotation twins and a corresponding change in the c/a ratio. At sufficiently high densities of these twins, the tetragonal structure is stabilized. Correlations between c/a ratio and twin densities with the critical temperature and diamagnetic yield are reported. DOE

N88-18469# Sandia National Labs., Albuquerque, N. Mex.
IMPROVED MAGNETIZATION FOR YBa2Cu3O/SUB 7-DELTA ANNEALED IN OXYGEN ABOVE 1000 C
E. L. Venturini, D. S. Ginley, R. J. Baughman, B. Morosin, and J. F. Kwak Nov. 1987 4 p Presented at the Fall Meeting of the Materials Research Society, Boston, Mass., 30 Nov. 1987
(Contract DE-AC04-76DP-00789)
(DE88-003934; SAND-87-2482C; CONF-871124-30) Avail: NTIS HC A02/MF A01

Air sintering and subsequent oxygen annealing at high temperatures are integral to the production of ceramic superconducting YBa sub 2 Cu sub 3 O sub 7- delta. We present results directed toward optimizing the temperature for these two process steps, using static magnetization to determine the intragranular properties. Surprisingly, pure oxygen stabilized the material against decomposition at temperatures near the melting point, allowing the production of significantly higher quality single phase material. DOE

N88-18470# Sandia National Labs., Albuquerque, N. Mex.
STABILITY DIAGRAMS FOR EPITAXIAL STRAINED LAYERS
J. Y. Tsao, B. W. Dodson, and S. T. Picraux 1987 7 p Presented at the Fall Meeting of the Materials Research Society, Boston, Mass., 30 Nov. 1987
(Contract DE-AC04-76DP-00789)

(DE88-003935; SAND-87-1504C; CONF-871124-31) Avail: NTIS HC A02/MF A01

For bulk materials, plastic deformation mechanisms and rates depend in a complex way on resolved shear stress and temperature, but can be succinctly described using deformation mechanism maps. We describe the use of such maps to demarcate the various stability and metastability regimes of single and multilayered strained epitaxial structures, and to interpret experimental work in the SiGe system. DOE

N88-18471# Sandia National Labs., Albuquerque, N. Mex.
FREESTANDING FILMS OF YBa2Cu3O/SUB 6.9/
D. S. Ginley, M. A. Mitchell, W. Fu, J. F. Kwak, E. L. Venturini, and R. J. Baughman 1987 4 p Presented at the Fall Meeting of the Materials Research Society, Boston, Mass., 30 Nov. 1987 Prepared in cooperation with MIT, Cambridge
(Contract DE-AC04-76DP-00789)
(DE88-003995; SAND-87-2750C; CONF-871124-22) Avail: NTIS HC A02/MF A01

Thick (20 to 300 micron) freestanding films of ceramic YBa sub 2 Cu sub 3 O sub 6.9 have been obtained by resintering YBa sub 2 Cu sub 3 O sub 6.9 powder in air after screen printing onto fused silica substrates. An interfacial reaction occurs between the powder and the silica substrate which efficiently debonds the resintered film upon cooling. The magnetization and transport properties of these films are comparable to those for high quality bulk ceramic samples. DOE

N88-18472# Brookhaven National Lab., Upton, N. Y.
THE EFFECT OF MAGNETIC IMPURITIES AND BARRIERS ON THE MAGNETIZATION AND CRITICAL CURRENT OF FINE FILAMENT NbTi COMPOSITES
A. K. Ghosh, W. B. Sampson, E. Gregory, S. Kreilick, and J. Wong 1987 4 p Presented at the 10th International Conference on Magnet Technology (MT-10), Boston, Mass., 21 Sep. 1987 Prepared in cooperation with Supercon, Inc., Shrewsbury, Mass.
(Contract DE-AC02-76CH-00016)
(DE88-004443; BNL-40543; CONF-870901-23) Avail: NTIS HC A02/MF A01

It has been shown that the highest critical currents in fine filament NbTi conductors are obtained when the filaments are closely spaced. However, the filaments in a composite with a high purity copper matrix tend to be coupled via the proximity effect as the filament spacing is reduced leading to large magnetization at low fields. To reduce the proximity coupling, trial billets of NbTi have been fabricated with Cu-30 percent Ni matrix, Cu-0.5 percent Mn matrix and one with a Ni barrier around the filaments. Wires drawn from these billets have shown that this interfilament coupling can be suppressed for very small filament separations. A full sized commercial billet with Cu-0.5 percent Mn matrix demonstrates that high J/sub c/ conductors with filament size approx. 1 to 5 microns can be fabricated which show no interfilament coupling at low fields. DOE

N88-18473# Sandia National Labs., Albuquerque, N. Mex.
ORDER-DISORDER TRANSITION OF Au AND Pt (110) SURFACES: THE SIGNIFICANCE OF RELAXATIONS AND VIBRATIONS
M. S. Daw and S. M. Foiles Dec. 1987 22 p
(Contract DE-AC04-76DR-00789)
(DE88-004651; SAND-87-8867) Avail: NTIS HC A03/MF A01

The Embedded Atom Method (EAM) has been combined with Monte Carlo simulations to study the structure and order-disorder transformation of Au and Pt (110) surfaces. We find that the missing row structure of Au disorders at 570 K, in close agreement with the experimental value of 650 K. For Pt, we predict a transformation at 750 K. Relaxations and vibrations are found to be essential for the accurate calculation of the critical temperature. DOE

N88-18474# Illinois Univ., Urbana.
TRANSPORT AND RELAXATION PROCESSES IN SUPERCRITICAL FLUIDS Technical Progress Report, 16 Sep. - 15 Dec. 1987
J. Jonas 1987 8 p
(Contract DE-FG22-85PC-80503)
(DE88-004804; DOE/PC-80503/T9) Avail: NTIS HC A02/MF A01

Our efforts were concentrated on measurements of relaxation times for the system naphthalene-supercritical ethylene and on theoretical analysis of extensive diffusion data on liquid 2-ethylhexyl-benzoate. Recent work has dealt primarily with the reorientation of naphthalene in supercritical carbon dioxide. Though these and earlier investigations of this system have provided an understanding of transport and relaxation processes in supercritical fluid mixtures, it was decided that studying the reorientation of d sub 8-naphthalene in supercritic al ethylene would complement our understanding of this type of system. As before, we measured the deuterium spin-lattice relaxation time, T sub 1 , of the solid solute dissolved in the supercritical fluid. We also investigated a state consisting of liquid d sub 8-naphthalene and supercritical ethylene. Spin-lattice relaxation times of d sub 8-naphthalene were measured at two different temperatures as a function of ethylene pressure. The conditions a these temperatures of 45 and 30 C correspond to a region of the ethylene-naphthalene phase diagram where solid naphthalene is dissolved in supercritical ethylene. Though there is a great amount of data concerning this region due to the applicability of supercritical extraction processes, this is the only T sub 1 data, to our knowledge, which exists concerning this system. We intend to measure T sub 1 along another isotherm at 15 C. DOE

N88-18475# Brookhaven National Lab., Upton, N. Y.
GRAIN BOUNDARIES, PLANAR DEFECTS AND SUPERCONDUCTING PROPERTIES OF YBa2Cu3O7
J. Tafto, M. Suenaga, T. Wang, R. L. Sabatini, A. R. Moodenbaugh, and S. Levine Nov. 1987 4 p Presented at the Fall Meeting of the Materials Research Society, Boston, Mass., 30 Nov. 1987 Prepared in cooperation with State Univ. of New York, Stony Brook
(Contract DE-AC02-76CH-00016)
(DE88-003477; BNL-40465; CONF-871124-44) Avail: NTIS HC A02/MF A01

Polycrystalline samples of tetragonal YBa2Cu3O(sub 6.25) were transformed into the superconducting orthorhombic phase by annealing in an oxygen atmosphere at temperatures ranging from 400 to 850 C and then slowly cooled to room temperature (15 C/h). Transmission electron microscopy (TEM) images of these samples and samples prepared in the usual way show layers of amorphous or highly disordered material, several 100 nm thick, at a large fraction of the grain boundaries. Also all samples contain 10 to 100 nm thick sheets of disordered material which lie in the a-b planes and tend to run through the entire crystal grain. In the a-b planes we also observe dislocation loops, particularly in the as-quenched tetragonal samples and stacking faults in the heat-treated samples. We also frequently observe sets of twins with orthogonal habit planes within a crystal grain. We attribute the low critical current density in YBa2Cu3O7 to these planar faults and the disordered grain boundary regions, and discuss the TEM observations with reference to resistivity and inductive measurements. DOE

N88-18476# Ames Lab., Iowa.
SUPERCONDUCTIVITY AND PHASE STABILITY IN THE HEAVY RARE EARTH QUATERNARY COMPOUNDS RBa2Cu3O7 (R = Ho, Er, Tm, Yb, Lu)
H. C. Ku, H. D. Yang, R. W. McCallum, M. A. Noack, P. Klavins, R. N. Shelton, and A. R. Moodenbaugh Apr. 1987 4 p Presented at the Spring Meeting of the Materials Research Society, Anaheim, Calif., 21 Apr. 1987 Prepared in cooperation with Brookhaven National Lab., Upton, N.Y.
(Contracts DE-AC02-76CH-00016; W-7405-eng-82)
(DE88-003478; BNL-40481; CONF-870438-38) Avail: NTIS HC A02/MF A01

Phase stability and superconducting properties of heavy rare earth compounds RBa sub 2 Cu sub 3 O sub 7 (R = Ho, Er, Tm, Yb, Lu) were studied and found to be unstable above 950 C.

Transition temperatures depend heavily on starting materials, thermal history, oxygen content and the interpretation of the data. Magnetic rare earth ions have little effect on the transition temperature. However, these magnetic compounds should order magnetically, probably in the mK range. DOE

N88-18477# Brookhaven National Lab., Upton, N. Y.
SUPERCONDUCTING PROPERTIES AND STRUCTURAL CHARACTERIZATION OF HIGH T/SUB c/ OXIDES
A. R. Moodenbaugh, D. E. Cox, J. J. Hurst, T. Asano, R. L. Sabatini, and M. Suenaga 1987 5 p Presented at the Conference on Advances in Cryogenic Engineering, St. Charles, Ill., 14 Jun. 1987
(Contract DE-AC02-76CH-00016)
(DE88-003479; BNL-40480; CONF-8706125-25) Avail: NTIS HC A02/MF A01

A desire to provide good quality oxide superconducting specimens for research requires careful characterization of samples. Earlier, straightforward methods for preparation of La sub 2-x Sr sub x CuO sub 4 and YBa sub 2 Cu sub 3 O sub 7 superconductors were described. However, these methods are not completely defined, and samples prepared nominally according to recipe may vary in superconducting properties and with respect to the presence of nonsuperconducting minority phases (primarily observed in X-ray diffraction work). Here we describe methods of preparation for these oxides which we utilized, and of techniques used to evaluate these materials. DOE

N88-18478# Brookhaven National Lab., Upton, N. Y.
PENETRATION DEPTH MEASUREMENTS OF YBa2Cu3O/SUB 7-DELTA/ AT 4 MHz
H. Wiesmann, R. R. Corderman, A. R. Moodenbaugh, and M. Strongin 1987 4 p Presented at the Fall Meeting of the Materials Research Society, Boston, Mass., 30 Nov. 1987
(Contract DE-AC02-76CH-00016)
(DE88-003493; BNL-40489; CONF-871124-46) Avail: NTIS HC A02/MF A01

Measurements were made of the penetration depth of bulk and powder samples of YBa sub 2 Cu sub 3 O sub 7-delta. The samples were placed in an inductor which was part of the resonant circuit of a 4 MHz tunnel diode oscillator. The oscillator was stable to at least 1 part in 10 * at 77 K. Changes in the sample susceptibility were easily detected by changes in the oscillator frequency. Analysis of the smallest powders fabricated gave a value of the measured penetration depth lambda sub mea = 0.23 microns. The measurement methodology is quantitative and the value of lambda sub mea is believed to be an upper bound of the true penetration depth. DOE

N88-18479# Brookhaven National Lab., Upton, N. Y.
THE ELECTRONIC STRUCTURE OF YBa2Cu3O/SUB 7-DELTA/ ABOVE AND BELOW T/SUB c/
S. L. Qiu, M. W. Ruckman, P. D. Johnson, J. Chen, L. Jiang, C. L. Lin, M. Strongin, B. Sinkovic, and N. Brookes 1987 17 p Presented at the Thin Film Processing and Characterization of High Temperature Superconductors, Anaheim, Calif., 6 Nov. 1987 Prepared in cooperation with Bell Labs., Murray Hill, N.J. and Texas Univ., Austin
(Contract DE-AC02-76CH-00016)
(DE88-003495; BNL-40441; CONF-871178-2) Avail: NTIS HC A03/MF A01

The electronic structure of YBa2Cu3O(sub 7-delta) has been investigated using synchrotron radiation above and below the superconducting transition temperature. Valence band spectra show a low density of states at the Fermi level, a shift of the Cu3d-O2p derived bands approx. 1.5 eV below their calculated binding energy and a Cu 3p-3d shake-up satellite that suggests localization of the copper 3d-states and also suggests that the copper ions have 2+ valence. Core-level spectra also give evidence of the Cu(2+) ion and show at least two distinct oxygen bonding environments. Cooling the surface to 20K leaves the Cu and Ba core-levels unmodified, may produce a new O 1s core-level component at 533 eV and causes a small change in the shape of the valence band. The Cu 3p-3d satellite is weaker and increased photoemission coincident with states derived from the O 2p orbitals at the Cu 3p threshold is noted in the valence band. These changes upon cooling suggest that small changes in the Cu-O electronic states occur and their possible relevance to superconductivity is discussed. DOE

N88-18480# California Univ., Berkeley. Lawrence Berkeley Lab.
SIMULATION AND PROCESSING OF HIGH RESOLUTION IMAGES OF DEFECTS AND INTERFACES IN SUPERCONDUCTING YBa2Cu3O7
H. W. Zandbergen, R. Gronsky, K. Wang, and G. Thomas Nov. 1987 10 p Presented at the Fall Meeting of the Materials Research Society, Boston, Mass., 30 Nov. 1987
(Contract DE-AC03-76SF-00098)
(DE88-003856; LBL-24140; CONF-871124-24) Avail: NTIS HC A02/MF A01

The superconducting performance, in particular the critical current, of polycrystalline YBa sub 2 Cu sub 3 O sub 7 will depend strongly on the structure of grain boundaries and the nature and a number of defects in the microstructure. To characterize the atomic structure of defects and grain boundaries in these materials, a high resolution electron microscopy study has been initiated. Emphasis was placed on the technique of phase contrast imaging with corresponding computer simulation and processing for optimum interpretation of results. DOE

N88-18481# Massachusetts Inst. of Tech., Cambridge. Dept. of Mechanical Engineering.
BRITTLE TO DUCTILE TRANSITION TO CLEAVAGE FRACTURE Progress Report, 1 Apr. - 30 Nov. 1987
A. S. Argon 1987 7 p
(Contract DE-FG02-87ER-45294)
(DE88-004074; DOE/ER-45294/T1) Avail: NTIS HC A02/MF A01

The brittle-to-ductile transition in cleavage fracture in single crystals is being studied both experimentally and theoretically as the key problem in such fracture transitions exhibited by intrinsically brittle (cleavable) polycrystalline solids. The intrinsic process that governs the transition is thermally assisted dislocation emission from the tips of atomically sharp cleavage cracks at the verge of propagation, which then provide effective crack tip shielding and blunting. All other phenomena known to influence the transition in fracture, such as shielding provided through the polarization of free dislocations in the distant field, micro-crack initiation, etc., are identified as extrinsic processes that merely shift the basic transition to lower temperatures or higher crack velocities, or consider formation of cracks with the required velocity for cleavage propagation. DOE

N88-18482# Los Alamos National Lab., N. Mex.
INNOVATIVE ARRANGEMENTS FOR INDUSTRY/DOE LABORATORY COLLABORATION IN HIGH TEMPERATURE SUPERCONDUCTIVITY
J. M. Williams 1988 8 p Presented at the 15th Annual Energy Technology Conference and Exposition, Washington, D.C., 17 Feb. 1988
(Contract W-7405-eng-36)
(DE88-004320; LA-UR-87-4010; CONF-880212-3) Avail: NTIS HC A02/MF A01

This report discusses some of the reasons it is necessary for universities, the Department of Energy, and industry to cooperate in developing new high temperature superconductors. DOE

N88-18483# California Univ., Berkeley. Lawrence Berkeley Lab.
GRAZING INCIDENCE X-RAY SCATTERING STUDY OF DEFECT STRUCTURES IN MBE GaAs/Si USING SYNCHROTRON RADIATION
S. S. Laderman, J. Kortright, M. Scott, and A. Fischer-Colbrie Apr. 1987 7 p Presented at the Materials Research Society Symposium on Heteroepitaxy on Silicon 2, Anaheim, Calif., 21 Apr. 1987

(Contract DE-AC03-76SF-00098)
(DE88-004556; LBL-24166; CONF-8704252-1) Avail: NTIS HC A02/MF A01

Defect structures in thin, molecular beam epitaxy (MBE) grown, GaAs/Si(001) heteroepitaxial films were studied with grazing incidence X-ray scattering techniques. The diffuse scattering associated with GaAs having the predominant epitaxial orientation varied strongly with the penetration depth of the X-rays. Well-directed streaks corresponding to planar faults were observed and easily distinguished from a broad and more randomly oriented background. Bragg peaks corresponding to twinned GaAs were also studied. The intensity and breadth of the twin reflections were analyzed to estimate the corresponding defect density. The depth dependence of the twinning probability was seen to vary with growth parameters. DOE

N88-18484# Brookhaven National Lab., Upton, N. Y.
HIGH-RESOLUTION X-RAY MICROSTRUCTURAL STUDY OF SINGLE CRYSTALS OF YBa2Cu3O/SUB 7-y/
Hoydoo You, J. D. Axe, X. B. Kan, S. C. Moss, J. Z. Liu, and D. J. Lam 1987 5 p Presented at the Fall Meeting of the Materials Research Society, Boston, Mass., 30 Nov. 1987 Prepared in cooperation with Houston Univ., Tex. and Argonne National Lab., Ill.
(Contracts DE-AC02-76CH-00016; W-31109-eng-38)
(DE88-004856; BNL-40590; CONF-871124-56) Avail: NTIS HC A02/MF A01

Single crystals of YBa2Cu3O(sub 7-y) were studied by transmission Laue photography and monochromatic diffraction techniques, using the Cornell High Energy Synchrotron Source and a rotating anode X-ray source. A new type of twinning with two orthorhombic domains rotated exactly 90 degree about the c axis, was observed in one sample and the conventional (110) type twinning in another sample with nominally identical growth conditions. A high resolution diffraction study of the sample with the conventional (110) twinning shows that measured orthorhombicity (proportional to oxygen ordering parameter) varies from one domain to another. DOE

N88-18485# Iowa State Univ. of Science and Technology, Ames. Microelectronics Research Center.
SYNTHESIS AND CHARACTERIZATION OF THIN FILMS Final Report, 1 Sep. 1984 - 30 Nov. 1986
K. M. Lakin 10 Jul. 1987 371 p
(Grant AF AFOSR-0388-84)
(AD-A187335; AFOSR-87-1393TR) Avail: NTIS HC A16/MF A01 CSCL 13H

This report summarizes a program which involved the installation of the individual systems of a major thin film facility and the results of initial film growth studies using the facility. Work in the growth of aluminum and germanium on silicon, germanium on gallium arsenide, and lithium niobate on silicon and sapphire is reported. GRA

N88-18486# Illinois Univ., Chicago. Dept. of Physics.
MBE GROWTH, CHARACTERIZATION AND ELECTRONIC DEVICE PROCESSING OF HgCdTe, HgZnTe RELATED HETEROJUNCTIONS AND HgCdTe-CdTe SUPERLATTICES Quarterly Report
Jean-Pierre Faurie 15 Mar. 1987 23 p
(Contract F49620-87-C-0021)
(AD-A187456; AFOSR-87-1628TR) Avail: NTIS HC A03/MF A01 CSCL 20L

Results are obtained for MBE grown N & P-type layers in terms of carrier concentration and electron or hole mobilities. Most layers were grown after the start date of the current contract. It is important to point out that even if these results are the best ever obtained in the laboratory they are representative of our level of control concerning the growth. Numerous layers with the same composition exhibit very similar results. A new Hg cell, which is a prototype built by ISA - Riber is currently being tested in the laboratory. This cell that we have conceived gives a very stable Hg flux during hours of growth. It should be noted that both mobility and carrier concentration values are suitable for IR device application. GRA

N88-18487# Minnesota Univ., Minneapolis.
MICROSCOPIC CONTROL OF METALLIZATION STABILITY Interim Report, 1 Aug. 1986 - 31 Aug. 1987
S. Chang, P. Philip, C. Caprile, A. Wall, and A. Franciosi 23 Oct. 1987 7 p
(Contract N00014-84-K-0545)
(AD-A187553; TR-15) Avail: NTIS HC A02/MF A01 CSCL 09A

Metallization stability on semiconductor surfaces depends on atomic interdiffusion at two interfaces, namely the semiconductor metal junction and the overlayer atmosphere interface. Recent progress in controlling the stability of these interfaces has been derived from the use of powerful nondestructive analytical tools of local interface composition. We summarize here synchrotron radiation photoemission studies of metallic overlayers on Si(111) and GaAs(110) surfaces. We focus on the use of diffusion barriers to control atomic interdiffusion, and on the effect of oxidizing atmospheres on metal and semiconductor composition. GRA

N88-18488# Minnesota Univ., Minneapolis. Dept. of Chemical Engineering and Materials Science.
LOCAL STOICHIOMETRY AND ATOMIC INTERDIFFUSION DURING REACTIVE METAL/MERCURY-CADMIUM-TELLURIDE JUNCTION FORMATION Interim Report
A. Wall, A. Raisanen, S. Chang, P. Philip, and N. Troullier 23 Oct. 1987 19 p Prepared in cooperation with McDonnell Douglas Research Lab., St. Louis, Mo.
(Contract N00014-84-K-0545)
(AD-A187554; TR-12) Avail: NTIS HC A03/MF A01 CSCL 07B

We summarize synchrotron radiation photoemission studies of Ag, Ge and Sm overlayers on Hg1-xCdxTe (110) surfaces. These metals exhibit widely different interface reactivity with Hg1-xCdxTe and yield a range of different interface morphologies. To assess the relative importance of the microscopic driving forces that determine the local composition at the interface and in the semiconductor near surface region we present a systematic comparison of our data with calculated thermodynamic parameters such as the cation-metal heat of solution, the heat of alloying from Miedema's semiempirical model, and the metal telluride formation enthalpy. GRA

N88-18489# Minnesota Univ., Minneapolis. School of Physics and Astronomy.
SUPERCONDUCTIVITY OF THIN FILM INTERMETALLIC COMPOUNDS Final Technical Report, 1 Sep. 1986 - 31 Aug. 1987
A. M. Goldman 30 Sep. 1987 33 p
(Grant AF AFOSR-0347-84)
(AD-A187563; AFOSR-87-1586TR) Avail: NTIS HC A03/MF A01 CSCL 20C

Investigations of both macroscopic and microscopic properties of thin film superconducting materials have been carried out. Compounds under study prior to the discovery of high-Tc superconductors, were either technologically significant, or involved possible unique mechanisms for superconductivity whose realization might extend the range of critical parameters. These include low carrier density superconductors, selected Heavy Fermion Compounds, and Chevrel Phase superconductors. Among the low-carrier density systems were films of Lead Tellurium and mixtures of Lanthanium Sulfide. These were prepared with the idea of ultimately fabricating FET-like devices. Films of the Heavy Fermion Compounds UPt3 and UBe13 were prepared and the critical fields and proximity effects in the latter were studied. With the advent of the high-Tc materials the program shifted to their study and measurements of their time-dependent magnetization, XPS spectra, and tunneling spectra were carried out on both bulk and thin film materials. GRA

N88-18490# Minnesota Univ., Minneapolis. Dept. of Chemical Engineering and Materials Science.
NONMONOTONIC EVOLUTION AND THERMODYNAMIC TRENDS AT METAL/(Hg,Cd)Te INTERFACES: Yb/Hg0.78Cd0.22Te Interim Report, 1 Aug. 1986 - 31 Aug. 1987

D. J. Peterman, A. Raisanen, S. Chang, P. Philip, and A. Wall 23 Oct. 1987 20 p Prepared in cooperation with McDonnell Douglas Research Lab., St. Louis, Mo.
(Contract N00014-84-K-0545)
(AD-A187591; TR-14) Avail: NTIS HC A03/MF A01 CSCL 20L

The microscopic interaction of cleaved Hg0.78Cd0.22Te surfaces with the highly reactive rare-earth Yb was studied by use of photoemission spectroscopy and synchrotron radiation. We compare the results with those of our previous investigation of Sm/(Hg,Cd)Te interface formation. Both overlayers exhibit a dramatic recovery of the Hg concentration at the interface after the first stage of metal-Te reaction. However, differences in valency between Sm and Yb develop during metal deposition and lead to differences in interface morphology. GRA

N88-18491# Minnesota Univ., Minneapolis. Dept. of Chemical Engineering and Materials Science.
CdTe(110)-Mn INTERFACE REACTION AND THE FORMATION OF NON-EQUILIBRIUM TERNARY SEMIMAGNETIC SEMICONDUCTOR ALLOYS Interim Report
A. Wall, A. Raisanen, S. Chang, N. Troullier, and A Franciosi 23 Oct. 1987 8 p Prepared in cooperation with Purdue Univ., West Lafayette, Ind.
(Contract N00014-84-K-0545)
(AD-A187593; TR-13) Avail: NTIS HC A02/MF A01 CSCL 20C

Because of the high stability of the divalent Mn atomic configuration Mn atoms diffuse readily in II-VI semiconductors. We have synthesized for the first time non-equilibrium ternary alloys through interface reaction in situ of CdTe single crystals and Mn thin films. We analyzed the electronic structure of these phases with synchrotron radiation resonant photoemission and probed their composition through escape-depth-dependent core level photoemission. GRA

N88-17702*# GTE Labs., Inc., Waltham, Mass.
A PAYLOAD FOR INVESTIGATING THE INFLUENCE OF CONVECTION ON GaAs CRYSTAL GROWTH
Alfred H. Bellows and Glenn A. Duchene *In* NASA. Goddard Space Flight Center, The 1987 Get Away Special Experimenter's Symposium Feb. 1988 p 77-82 (For primary document see N88-17691 10-12)
(Contract NAS3-24644)
Avail: NTIS HC A08/MF A01 CSCL 20L

77 THERMODYNAMICS AND STATISTICAL PHYSICS

Includes quantum mechanics; theoretical physics; and Bose and Fermi statistics.

For related information see also *25 Inorganic and Physical Chemistry* and *34 Fluid Mechanics and Heat Transfer.*

N88-18492# Gosudarstvennyj Komitet po Ispolzovaniyu Atomnoi Energii, Serpukhov (USSR).
HAMILTONIAN APPROACH TO RELATIVISTIC THEORY OF GRAVITY AND TO GENERAL RELATIVITY THEORY
V. O. Solovev 1986 40 p In RUSSIAN
(DE88-700404; IFVE-OTF-86-190) Avail: NTIS (US Sales Only) HC A03/MF A01

The basic points of the canonical formalism of relativistic theory of gravity (RTG) and general relativity theory (GRT) are presented. The required preliminary information from the theory of constrained systems and the hypersurfaces geometry are given. The presence of the Minkowsky space in the RTG is shown to be the fundamental difference between the RTG and GRT. It allows one to speak about the localization of the energy-momentum of the gravitational field in this theory. DOE

N88-18493 Washington Univ., Seattle.
SUPERFLUID TURBULENCE IN He II AT ELEVATED PRESSURES Ph.D. Thesis
Kazuki Mimura [1987] 127 p
Avail: Univ. Microfilms Order No. DA8722466

The properties of superfluid turbulence in He II at elevated pressures were studied at 1.385 and 1.600 K. The temporal profiles of the temperature gradient in counterflow channels were observed following an application of heat pulses. Two large-aspect-ratio rectangular channels, each equipped with two heaters at the closed end and three thin-film superconducting bolometers, equally spaced along the channel length, were used. From the steady state results, the dimensionless coefficient, which appears in the Schwarz theory of superfluid turbulence, was obtained as a function of temperature and pressure dependent quantity. The obtained results are in excellent agreement with the computed results obtained by Schwarz. In effect, the present work extends the verification of Schwarz's vortex reconnection model to He II at pressures of up to 24 bar. New data were also yielded on the growth and decay of superfluid turbulence in He II at elevated pressures. The values of Vinen's growth and decay parameters, chi sub1 and chi sub 2, are obtained from the analysis of transient behavior of temperature gradients in the channel. Dissert. Abstr.

N88-18494# Rockefeller Univ., New York. Dept. of Physics.
STATUS OF THE ELECTROWEAK THEORY
A. Sirlin 1987 22 p Presented at the International Symposium on Lepton and Photon Interactions At High Energies, Hamburg, Fed. Republic of Germany, 27 Jul. 1987
(Contract DE-AC02-87ER-40325)
(DE88-002342; DOE/ER-40325/03; RU-87/B1/15; CONF-870797-8) Avail: NTIS HC A03/MF A01

The status of the electroweak theory is discussed. Particular emphasis is placed on the quantum corrections, constraints on new physics and recent developments concerning the KMC matrix, B sub 0 - B sub 0 oscillations, CP violation, neutral currents, vector boson masses and solar neutrinos. DOE

N88-18495# Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of Theoretical Physics.
ON THE DYNAMICAL SUPERSYMMETRY OF ATOMIC HYDROGEN
L. A. Slepchenko 1986 6 p In RUSSIAN
(DE88-700713; JINR-R-2-86-148) Avail: NTIS (US Sales Only) HC A02/MF A01

In the framework of supersymmetric quantum mechanics a dynamical symmetry of the hydrogen atom is considered. New features of spectra for the dynamical supersymmetry of two-dimensional Kepler problem are found. DOE

N88-18496# Fermi National Accelerator Lab., Batavia, Ill.
ZERO TEMPERATURE QUARK MATTER EQUATION OF STATE
F. Grassi Sep. 1987 29 p Presented at the Workshop on Variational Calculations in Quantum Field Theory, Wangerooge, Fed. Republic of Germany, 1 Sep. 1987
(Contract DE-AC02-76CH-03000)
(DE88-003408; FNAL/C-87/167-A; CONF-8709219-1) Avail: NTIS HC A03/MF A01

An equation of state is computed for a plasma of one flavor quarks interacting through some phenomenological potential, in the Hartree approximation, at zero temperature. Assuming that the confining potential is scalar and color-independent, it is shown that the quarks undergo a first-order mass phase transition. In addition, due to the way screening is introduced, all the thermodynamic quantities computed are independent of the actual shape of the interquark potential. This equation of state is then generalized to a potential with scalar and vector components.

Fock corrections are discussed and the case of a several quark flavor plasma is studied. DOE

N88-18497# Washington Univ., Seattle. Dept. of Physics.
AN OVERVIEW OF THE TRANSACTIONAL INTERPRETATION OF QUANTUM MECHANICS
J. G. Cramer 1987 24 p
(Contract DE-AC06-81ER-40048)
(DE88-004236; DOE/ER-40048/206-L7) Avail: NTIS HC A03/MF A01

We summarize the transactional interpretation (TI) of quantum mechanics (QM) and consider various points concerning the TI and its relation to the Copenhagen interpretation (CI). Questions concerning mapping the TI onto the CI, of advanced waves as solutions to proper wave equations, of collapse and the QM formalism, and of the relation of quantum mechanical interpretations to experimental tests and results are discussed. DOE

N88-18498# Los Alamos National Lab., N. Mex.
ANTIMATTER: ITS HISTORY AND ITS PROPERTIES
M. M. Nieto and R. J. Hughes 1987 22 p Presented at the 2d Review and Planning Workshop on Antiproton Science and Technology, Santa Monica, Calif., 6 Oct. 1987
(Contract W-7405-eng-36)
(DE88-004308; LA-UR-87-4119; CONF-8710125-7) Avail: NTIS HC A03/MF A01

The conceptual developments of quantum theory and special relativity which culminated in the discovery of and understanding of antimatter are reviewed. In particular, it is emphasized how quantum theory and special relativity together imply that antimatter must exist. Our modern understanding of antimatter is summarized in the CPT theorem of relativistic quantum field theory. The implications of this theorem have never been contradicted. DOE

N88-18499# Harvard Univ., Cambridge, Mass.
FUNDAMENTAL PROPERTIES OF SPIN-POLARIZED QUANTUM SYSTEMS Technical Progress Report
1987 8 p
(Contract DE-FG02-85ER-45190)
(DE88-004425; DOE/ER-45190/1) Avail: NTIS HC A02/MF A01

This paper discusses the progress in the following areas: stability in ultra-high fields, resonant two-body recombination, microwave cooling of atomic hydrogen, three-body recombination on surfaces, hydrogen maser, parasitic helium-3 cooling, hydrogen condensed on helium surfaces, and cross beam scattering of hydrogen. DOE

N88-18500# Chicago Univ., Ill.
STUDIES IN FINITE TIME THERMODYNAMICS Progress Report, 1 Apr. 1987 - 31 Mar. 1988
R. S. Berry Dec. 1987 4 p
(Contract DE-FG02-86ER-13488)
(DE88-004531; DOE/ER-13488/2) Avail: NTIS HC A02/MF A01

This paper briefly discusses work in progress in the following areas: determination of optimal current paths for electrochemical systems, analysis of the production of entropy when a beam of atoms is stopped by the absorption and reemission of laser light, the use of a variational method for the treatment of transport processes and related nonequilibrium states, and a cooperative effort to resolve the controversy concerning the use of various metrics in a space of thermodynamic variables. DOE

N88-18501# California Univ., Berkeley. Lawrence Berkeley Lab. Materials and Chemical Sciences Div.
UTILIZATION OF THE JANAF (JOINT ARMY NAVY AIR FORCE) DATABASE FOR CHEMICAL THERMODYNAMIC CALCULATIONS Ph.D. Thesis
A. S. Bafi Dec. 1987 83 p
(Contract DE-AC03-76SF-00098)
(DE88-004571; LBL-24514) Avail: NTIS HC A05/MF A01

A computer code is presented here that calculates the standard-state free energy change and the equilibrium constant for a specified reaction $aA + bB = cC + dD$. In computing these values, this code utilizes the Joint Army Navy Air Force (JANAF) thermochemical data file. If desired, certain additional thermodynamic values for the individual reactants and products can also be included in the output of this code. DOE

N88-18502# North Carolina Univ., Chapel Hill. Dept. of Physics and Astronomy.
RESEARCH IN THEORETICAL PHYSICS: RESULTS FROM LAST YEAR 1986/87
P. H. Frampton, Y. J. Ng, and H. VanDam 1987 10 p
(Contract DE-FG05-85ER-40219)
(DE88-004922; DOE/ER-40219/3) Avail: NTIS HC A02/MF A01

This paper briefly discusses the following topics: particle phenomenology, superstring formalism, superstring applications, narrow electron-positron peaks in heavy-ion collisions and the confining phase of QED, novel bosonic strings, interactions involving higher spin massless particles, and classical action at a distance theories which contain a cutoff. DOE

80 SOCIAL SCIENCES (GENERAL)

Includes educational matters.

No abstracts in this category.

81 ADMINISTRATION AND MANAGEMENT

Includes management planning and research.

N88-18503# Indo-US Subcommission on Science and Technology, Washington, D.C.
MINUTES OF THE MEETING OF THE INDO-US SUBCOMMISSION ON SCIENCE AND TECHNOLOGY (8TH) HELD AT WASHINGTON, D.C. ON SEPTEMBER 22-24, 1986
1986 89 p Meeting held in Washington, D.C., 22-24 Sep. 1986
(PB88-130158) Avail: NTIS HC A05/MF A01 CSCL 05A

To carry out the objectives of the agreement in various fields of science and technology, the Indo-U.S. Subcommission on Science and Technology was established in January 1975. Since then it has met on eight occasions in either Washington or New Dehli and has played an important role in fostering the development of collaborative research projects of mutual interest as well as closer ties between the scientific communities of both countries. The Secretary of the Department of Science and Technology on the Indian side, and the Assistant Secretary of State for Oceans and International Environment and Scientific Affairs on the U.S. side, co-chair the meetings of the Subcommission. More than two dozen technical agencies from both sides participate in the activities of the Subcommission. The work of the Subcommission is carried out by Working Groups in physical and materials science; earth, atmospheric, and marine sciences; energy; environment and ecology; information science and technology; and health, medical, and life sciences. The document presents the minutes of the Eighth Meeting of the Indo-U.S. Subcommission on Science and Technology which was held in Washington, D.C., September 22-24, 1986, and reports on the deliberations of the various Working Groups. Author

N88-18504# Massachusetts Inst. of Tech., Cambridge. Energy Lab.
A COLLABORATIVE PROGRAM OF RESEARCH IN ENGINEERING SCIENCES
Mar. 1987 458 p Prepared in cooperation with Idaho National

Engineering Lab., Idaho Falls
(Contracts DE-FG02-85ER-13331; DE-AC06-87RL-10930)
(DE88-003383; DOE/ER-13331/1) Avail: NTIS HC A20/MF A01

This proposal describes a collaborative program of energy-related engineering research. The proposal builds upon, and extends, research begun in 1985. Research areas in the initial program were: thermal plasmas; automated welding; engineering analyses and design; and solid mechanics. Work in these areas will continue. New projects are proposed in the area of sensors and diagnostics. Each organization, MIT and Idaho National Engineering Labratory (INEL), will conduct research in each of the areas. The research projects are coordinated between institutions and are designed to enhance the productivity of the program by exploiting the separate strengths of each organization. The MIT segment of the program involves 18 faculty members, 8 professional staff members, and 31 graduate research assistants. The program is planned for a 5-year duration. DOE

N88-17820# Messerschmitt-Boelkow-Blohm G.m.b.H., Ottobrunn (West Germany).
RESEARCH, DEVELOPMENT, AND GROWTH STRATEGY [FORSCHUNG, ENTWICKLUNG UND WACHSTUMSSTRATEGIE]
Ludwig Boelkow *In its* Research and Development. Technical-Scientific Publications (1956-1987): Retrospective View and Prospects. Jubilee Edition on the Occasion of the 75th Anniversary of Dipl.-Engr. Dr.-Engr. E.H. Ludwig Boelkow 1987 p 19-24 In GERMAN Presented at the 6th Conseil International de l'Organisation Scientifique European Congress, Cannes, France, 25 Nov. 1968 (For primary document see N88-17819 10-31)
Copyright Avail: NTIS HC A14/MF A01

N88-17858# Messerschmitt-Boelkow-Blohm G.m.b.H., Bremen (West Germany). Unternehmensgruppe Raumfahrt.
PROJECT MANAGEMENT IN ASTRONAUTICS: FROM SPACELAB TO COLUMBUS [PROJEKT-MANAGEMENT IN DER RAUMFAHRT- VON SPACELAB ZU COLUMBUS]
Ants Kutzer *In its* Research and Development. Technical-Scientific Publications (1956-1987): Retrospective View and Prospects. Jubilee Edition on the Occasion of the 75th Anniversary of Dipl.-Engr. Dr.-Engr. E.H. Ludwig Boelkow 1987 p 257-262 In GERMAN Presented at a conference, Aachen, Fed. Republic of Germany, 29 Jan. 1987 (For primary document see N88-17819 10-31)
(MBB-URE-943/87) Copyright Avail: NTIS HC A14/MF A01

82 DOCUMENTATION AND INFORMATION SCIENCE

Includes information management; information storage and retrieval technology; technical writing; graphic arts; and micrography.

For computer documentation see *61 Computer Programming and Software.*

N88-18505# Strategic Air Command, Offutt AFB, Nebr.
AIR FORCE GEOGRAPHIC INFORMATION AND ANALYSIS SYSTEM
D. A. Henney, D. S. Jansing, R. C. Durfee, S. M. Margle, and L. E. Till 1987 11 p Presented at the Geographic Information System Conference, San Francisco, Calif., 27 Oct. 1987 Prepared in cooperation with Civil Engineering Squadron, Sheppard AFB, Tex. and ORNL, Tenn.
(Contract DE-AC05-84OR-21400)
(DE88-001420; CONF-8710173-1) Avail: NTIS HC A03/MF A01

A microcomputer-based geographic information and analysis system (GIAS) was developed to assist Air Force planners with environmental analysis, natural resources management, and facility and land-use planning. The system processes raster image data, topological data structures, and geometric or vector data similar to that produced by computer-aided design and drafting (CADD) systems, integrating the data where appropriate. Data types included Landsat imagery, scanned images of base maps, digitized point and chain features, topographic elevation data, United States Geological Survey stream course data, highway networks, railroad networks, and land use/land cover information from United States Geological Survey interpreted aerial photography. The system is also being developed to provide an integrated display and analysis capability with base maps and facility data bases prepared on CADD systems. DOE

N88-18506# Rutgers - The State Univ., New Brunswick, N. J.
RESONANCE, INFORMATION, AND THE PRIMACY OF PROCESS: ANCIENT LIGHT ON MODERN INFORMATION AND COMMUNICATION THEORY AND TECHNOLOGY Ph.D. Thesis
Gordon Lynn Miller 1987 256 p
Avail: Univ. Microfilms Order No. DA8723276

An investigation into the historical and philosophical foundations of the concept of information is given. Information is equated with meaning, and the primary purpose is to develop a unitary process view of information. This view is unitary in the sense that information is seen as inhering in interactions between structures; it implies process in the sense that information is seen as continuously arising from moment to moment from a more richly structured ground. Dissert. Abstr.

N88-18507# Illinois Univ., Urbana-Champaign.
QUANTITATIVE AND QUALITATIVE ASSESSMENTS OF THE IMPACT OF LINGUISTIC THEORY ON INFORMATION SCIENCE Ph.D. Thesis
Amy Warner [1987] 240 p
Avail: Univ. Microfilms Order No. DA8721782

A citation analysis was performed on a subset of the information science literature to determine the impact of linguistic theory on information science. Both quantitative and qualitative measures were employed to show the relationship between the two fields. The overall findings indicate that this proportion of the information science literature has made almost no use of linguistic theory. The small number of citations to linguistic theory did show some patterns, indicating that small numbers of citing and cited authors account for most of the activity; that syntax and semantics have occupied more attention from information scientists than other branches of linguistic theory; that information scientists have cited older works over time; and that most of the citations to linguistic theory belong to qualitative non-use categories. Dissert. Abstr.

N88-18508# Brookhaven National Lab., Upton, N. Y.
USING SIR (SCIENTIFIC INFORMATION RETRIVAL) SYSTEM FOR DATA MANAGEMENT DURING A FIELD PROGRAM
Joyce L. Tichler 1987 14 p Presented at the USIR Annual Conference, Washington, D.C., 14 Oct. 1987
(Contract DE-AC02-76CH-00016)
(DE88-001555; BNL-40336; CONF-8710172-1) Avail: NTIS HC A03/MF A01

As part of the US Department of Energy's program, PRocessing of Emissions by Clouds and Precipitation (PRECP), a team of scientists from four laboratories conducted a study in north central New York State, to characterize the chemical and physical processes occurring in winter storms. Sampling took place from three aircraft, two instrumented motor homes and a network of 26 surface precipitation sampling sites. Data management personnel were part of the field program, using a portable IBM PC-AT computer to enter information as it became available during the field study. Having the same database software on the field computer and on the cluster of VAX 11/785 computers in use aided database development and the transfer of data between machines. DOE

N88-18509# Oak Ridge Gaseous Diffusion Plant, Tenn.
COMPUTER-AIDED DESIGN INFORMATION SYSTEM (CADIS): USER'S MANUAL
J. H. Rosser, ed., G. W. Scott, ed., and R. L. Schwarz, ed. Nov. 1987 152 p

(Contract DE-AC05-84OT-21400)
(DE88-004365; K/CSD/TM-76) Avail: NTIS HC A08/MF A01

The Computer-Aided Design Information System (CADIS) is a computerized system whose purpose is to provide a resource management tool for Engineering managers responsible for the CAD systems used in designing and fabricating products and facilities at the Department of Energy's plants and laboratory operated by Martin Marietta Energy Systems, Inc., in Oak Ridge, Tennessee. CADIS collects, manages, and reports information useful in planning CAD system expansions and upgrades; budgeting and appropriation of funds; acquisition and installation of hardware and software components; allocation of manpower and equipment; and training of engineers, designers, and draftsmen in the use of CAD systems. This user's manual provides a review of CADIS's purpose, its database structure, and the specific information the database contains. Examples are given of available CADIS reports, and tutorials are presented for performing on-line input and retrieval of information from the database. DOE

N88-18510# Oak Ridge National Lab., Tenn.
GUIDELINES FOR EXCHANGING COMPUTERIZED INFORMATION
R. J. Olson, T. A. Boden, J. A. Solomon, V. H. Dale, and S. W. Christensen 1987 6 p Presented at the Piecing the Puzzle Together: A Conference on Integrating Data for Decisionmaking, Washington, D.C., 27 May 1987
(Contract DE-AC05-84OR-21400)
(DE88-004736; CONF-8705147-4) Avail: NTIS HC A02

The exchange of computerized information is becoming more routine; however, it is often a time-consuming and frustrating process. Based on our experience in developing several large data bases at Oak Ridge National Laboratory, we estimate that there may be problems with at least one-third of the data files that are received or sent. The average time required to process data transferred from extant sources (based on records for 56 transfers) increased 37 percent when problems were encountered compared with the average processing time required for data files without significant problems. The majority of problems were related to inadequate documentation (49 percent). Other problems included hardware or software incompatibilities, errors in the tape or disk, errors or inconsistencies in the data, and transmittal of the wrong data set. Based on this analysis, we have developed guidelines for exchanging computerized information, giving the types of information needed to adequately document a file, define the transfer medium, and verify that information is correctly received. The guidelines are meant to be adapted to individual situations as appropriate. DOE

N88-18511* National Aeronautics and Space Administration, Washington, D.C.
NASA PATENT ABSTRACTS BIBLIOGRAPHY: A CONTINUING BIBLIOGRAPHY. SECTION 2: INDEXES (SUPPLEMENT 32)
Jan. 1988 499 p
(NASA-SP-7039(32)-SECT-2; NAS 1.21:7039(32)-SECT-2) Avail: NTIS HC A21; NTIS standing order as PB88-911100, $26.50 domestic, $53.00 foreign CSCL 05B

A subject index is provided for over 4700 patents and patent applications for the period May 1969 through December 1987. Additional indexes list personal authors, corporate authors, contract numbers, NASA case numbers, U.S. patent class numbers, U.S. patent numbers, and NASA accession numbers. Author

N88-18512# Naval Postgraduate School, Monterey, Calif.
OPTICAL MEMORY CARDS: A COMPARISON WITH OTHER CURRENT TECHNOLOGIES AND POTENTIAL MILITARY APPLICATIONS M.S. Thesis
Stephen H. Frink Sep. 1987 48 p
(AD-A187287) Avail: NTIS HC A03/MF A01 CSCL 14C

The storage and distribution of information has become increasingly more critical to the success of our daily endeavors. Nowhere is this more apparent than in the military community. As the amount of information each military unit must have to function efficiently and effectively increases, so does the space required to store it. This situation has prompted at least one high-level Navy official to initiate a program to test the concept of a paperless ship by 1990. At the head of the list of systems to meet the mass storage requirements of the program are the optical memory technologies. Included under this heading is the optical memory card, which is the size of a standard 54mm x 85mm wallet card and, in one particular configuration, is capable of storing 800 pages of text alone or 200 pages of combined test and graphics. Employing optical memory card technology in the paperless ship will reduce the space required to store technical manuals and directives by a factor of over 200. Two applications, i.e., a Technical Document Publishing and Update Program, and An Individual Personnel Record Storage and Update Program are discussed as potentially beneficial to the military community. GRA

N88-17634*# National Aeronautics and Space Administration. Ames Research Center, Moffett Field, Calif.
INFORMATION TRANSFER IN THE NATIONAL AIRSPACE SYSTEM
Alfred T. Lee *In* NASA. Langley Research Center, Airborne Wind Shear Detection and Warning Systems: First Combined Manufacturers and Technologists Conference Jan. 1988 p 507-515 (For primary document see N88-17616 10-03)
Avail: NTIS HC A24/MF A01 CSCL 05B

N88-18221# Ohio State Univ., Columbus. Dept. of Computer and Information Science.
CONCURRENCY CONTROL AND RELIABILITY IN REPLICATED DATABASE SYSTEMS
Mukesh Singhal *In* North Carolina Univ., Proceedings of the Workshop on Future Directions in Computer Architecture and Software 30 Aug. 1986 p 236-243 (For primary document see N88-18191 10-60)
Avail: NTIS HC A18/MF A01 CSCL 05B

83 ECONOMICS AND COST ANALYSIS

Includes cost effectiveness studies.

N88-18513# California Univ., Berkeley. Dept. of Mathematics.
EXPONENTIAL LOWER BOUNDS FOR FINDING BROUWER FIXED POINTS
M. D. Hirsch and S. Vavasis 1987 11 p Presented at the Symposium on the Foundation of Computer Science, Marina Del Rey, Calif., 12 Oct. 1987 Prepared in cooperation with Stanford Univ., Calif.
(Contract W-31-109-eng-38)
(DE88-002864; CONF-8710212-1-Summ) Avail: NTIS HC A03/MF A01

The Brouwer fixed point theorem has become a major tool for modeling economic systems during the 20th century. It was intractable to use the theorem in a computational manner until 1965 when Scarf provided the first practical algorithm for finding a fixed point of a Brouwer map. Scarf's work left open the question of worst-case complexity, although he hypothesized that his algorithm had typical behavior of polynomial time in the number of variables of the problem. Here we show that any algorithm for fixed points based on function evaluation (which includes all general purpose fixed-point algorithms) must in the worst case take a number of steps which is exponential both in the number of digits of accuracy and in the number of variables. DOE

N88-18514# Naval Postgraduate School, Monterey, Calif.
A COMPARISON OF PROJECTION METHODS IN THE FORECASTING OF OVERHEAD COSTS FOR SEVEN GOVERNMENT AEROSPACE CONTRACTORS M.S. Thesis
Christopher P. Schnedar Sep. 1987 69 p
(AD-A187572) Avail: NTIS HC A04/MF A01 CSCL 05C

Three types of forecasting models developed to predict overhead costs for seven government aerospace contractors are compared. The methodologies utilized to develop the models include generalized least squares, univariate Box-Jenkins, and

multivariate Box-Jenkins procedures. The results of those models are compared using three measures of effectiveness: correlation coefficient between actual and predicted values, root mean squared error divided by the mean of the actuals, and mean absolute percentage error (in percent). As was expected, the univariate Box-Jenkins method produced short term forecasts which were superior to those of the least squares regression models. However, the regression forecasts were highly accurate and were considerably less expensive to obtain. Only one multivariate Box-Jenkins model could be developed. The results of this model were marginally superior to the related regression model and significantly inferior to the univariate Box-Jenkins model for the same contractor. GRA

84 LAW, POLITICAL SCIENCE AND SPACE POLICY

Includes NASA appropriation hearings; aviation law; space law and policy; international law; international cooperation; and patent policy.

N88-17833# Messerschmitt-Boelkow-Blohm G.m.b.H., Ottobrunn (West Germany). Engineering and Manufacturing Div.
COOPERATION KNOW-HOW IN HIGH-TECH PRODUCTS
Horst Prem *In its* Research and Development. Technical-Scientific Publications (1956-1987): Retrospective View and Prospects. Jubilee Edition on the Occasion of the 75th Anniversary of Dipl.-Engr. Dr.-Engr. E.H. Ludwig Boelkow 1987 p 99-106 Presented at the Binational Conference on Asia-Pacific Dimensions of International Business: A Joint French-German Approach, Stuttgart, Fed. Republic of Germany, 16-17 Oct. 1986 Previously announced in IAA as A87-49966 (For primary document see N88-17819 10-31)
(MBB-Z-101/86) Copyright Avail: NTIS HC A14/MF A01

85 URBAN TECHNOLOGY AND TRANSPORTATION

Includes applications of space technology to urban problems; technology transfer; technology assessment; and surface and mass transportation.

For related information see also *03 Air Transportation and Safety, 16 Space Transportation,* and *44 Energy Production and Conversion.*

N88-18515# Sandia National Labs., Albuquerque, N. Mex.
INNOVATION AND CREATIVITY: A CRITICAL LINKAGE
J. M. Hueter 1987 7 p Presented at the College Industry Education Conference, San Diego, Calif., 8 Feb. 1988
(Contract DE-AC04-76DP-00789)
(DE88-003309; SAND-87-2801C; CONF-880234-1) Avail: NTIS HC A02

Creativity involves the associating of hitherto unrelated elements to form a new and useful combination. All have the ability but most seldom use it because of some false beliefs and failure to understand the creative process. Deterrents to creativity include fear of criticism, narrowness of education and training, habit, negative attitudes toward problems, lack of motivation, lack of self-confidence, lack of courage and discouragement by failures. The recognition and development of creative ideas requires mental effort, an open mind, searching seemingly unrelated fields and definition of the problem. Brainstorming is widely used to produce alternate ideas. Modifications of it are the Gordon Technique and Synectics. Morphological analysis and the examination of attributes are other aids to creativity. Recognition of a need, or of a new use of an old idea can be helpful. Management should encourage attempts at creativity. If the will exists, creativity can be developed by conscious effort instead of being left to chance. DOE

N88-18516# Vanderbilt Univ., Nashville, Tenn. Center for the Space Processing f Engineering Materials.
[NON-PROPRIETARY RESEARCH PROJECTS OF THE CENTER FOR THE SPACE PROCESSING OF ENGINEERING MATERIALS] Annual Report, 1 Nov. 1986 - 31 Oct. 1987
31 Oct. 1987 159 p
(AR-2) Avail: NTIS HC A08/MF A01

This second annual report of the Center for the Space Processing of Engineering Materials covers work done in the period 1 October 1986 to 31 October 1987. Included are reports on the following: The Effect of Microgravity on the Microstructure of Directionally Solidified Aluminum Alloys; Containerless Processing of Titanium-Aluminum Alloys; Deep Undercooling of Ni and Fe Aluminides; Ultra Purification of Niobium by Containerless Processing; Containerless Processing and Directional Solidification of Platinum Group Refractory Metal In-Situ Composite Materials; Containerless Processing of Titanium Alloys; Effect of Solidification Mode on Structure-Property Relationships of Lead-Base Immiscible Alloys (Pb-Cu, Pb-Al, Pb-Zn, Pb-Ni); Dispersion Strengthened Metal Alloys; Containerless Processing of Nb Based Alloys; and Oxide Strengthened High Temperature Alloys in the Nickel Chromium System. F.M.R.

N88-18517*# National Aeronautics and Space Administration. Ames Research Center, Moffett Field, Calif.
NETWORKING REQUIREMENTS AND FUTURE ALTERNATIVES
Alison Brown, A. Fredrick Fath, John Fitzgerald, Philip Gross, Dennis Hall, Jack Haverty, Charles M. Kennedy (Ballistic Research Labs., Aberdeen Proving Ground, Md.), Thomas Lasinski, Fred McClain, and Patrick McGregor et al. Jun. 1987 18 p
(Contracts DE-AC03-76SF-00098; W-7405-eng-48; DE-AC02-76CH-03000)
(NASA-TM-89711; NAS 1.15:89711; DE88-000465; LBL-23656; CONF-870277-2) Avail: NTIS HC A03/MF A01 CSCL 12B

The Working Group on Networking Requirements and Future Alternatives recommends creation of an international, interagency networking facility for science, whose 15-year mission is to ensure that US scientists have available the most advanced wide area networking facilities in the world, and to ensure that US wide area network technology maintains a position of world leadership. A minimum of 1.5 Mbit/s access to major government and academic research centers should be provided. Such a network would greatly benefit the competitive position of the United States in scientific research. It would also place the US in a leadership position in utilization of high bandwidth, wide area networks. United States industries supporting wide area network technologies would gain a significant competitive advantage over the other countries. An ongoing program of research and development into both wide area network technology and network management is necessary for this endeavor to be successful. As part of the second year study, the Working Group recommends that an interagency coordinating committee be established to identify short-term implementation issues that can be investigated and resolved in parallel with long-term issues. This would provide immediate benefit to the nation's scientific community. DOE

N88-18518# National Bureau of Standards, Gaithersburg, Md.
JOURNAL OF RESEARCH OF THE NATIONAL BUREAU OF STANDARDS, VOLUME 92, NUMBER 5, SEPTEMBER-OCTOBER 1987
1987 58 p
(PB88-124409) Avail: NTIS HC A04/MF A01 CSCL 05A

Articles in the Journal of Research of NBS include the following: An automated potentiometric system for precision measurement of the quantized hall resistance; the NBS large-area alpha-particle counting system; Mossbauer imaging; International intercomparisons of photometric base units. GRA

N88-18519# National Bureau of Standards, Gaithersburg, Md.
JOURNAL OF RESEARCH OF THE NATIONAL BUREAU OF STANDARDS, VOLUME 92, NUMBER 6, NOVEMBER-DECEMBER 1987

1987 54 p
(PB88-138516) Avail: NTIS HC A04/MF A01; also available SOD HC $3.00 as 703-027-00019-9 CSCL 05A

This issue of the NBS Journal of Research contains the following: reports on Standard Reference data information; international standards for nondestructive testing; superconductivity - challenge for the future; transient impact response of thick circular plates; transient impact response of plates containing flaws; and a low noise cascade amplifier. GRA

N88-18520# Los Alamos National Lab., N. Mex.
FUEL CELL/BATTERY HYBRID VEHICLE ASSESSMENT
H. S. Murray and J. R. Huff Oct. 1987 126 p
(Contract W-7405-eng-36)
(DE88-005087; LA-10948-MS) Avail: NTIS HC A07/MF A01

The concept of a hybrid vehicle has emerged as a result of the need to reduce petroleum consumption, to provide for pollution-free electric propulsion, and, at the same time, to maintain a full-performance capability comparable with conventional internal combustion engine powered vehicles. The purpose of this study is to examine the possibility of using a fuel cell/battery hybrid propulsion system configured to take advantage of the best attributes of both power sources. An assessment of the state-of-development of fuel cells and batteries was performed. Based on this assessment, the phosphoric acid (PA) and proton exchange membrane (PEM) fuel cells were selected for use in this study. Methanol was the choice for the fuel cell fuel. Lead-acid and nickel-zinc batteries were designated as the battery types to be used; the latter served as representative of advanced battery technology. A survey was made of DOE-sponsored programs on motors, controllers, and transmissions to provide specifications for the electric vehicle power train. The power plant is configured so that the fuel cell provides the average duty cycle power requirement and the battery serves to meet the peak power demands. DOE

N88-18521# Maryland Univ., College Park.
ON THE MANEUVERING OF VEHICLES
James C. Alexander and J. H. Maddocks 1987 14 p
(Grant AF AFOSR-0073-87)
(AD-A187632; AFOSR-87-1434TR) Avail: NTIS HC A03/MF A01 CSCL 13F

Equations are derived to govern the motion of vehicles which move on rolling wheels. A relation between the centers of curvature of the trajectories of the wheels and the center of rotation of the vehicle is established. From this relation the general kinematic laws of motion are derived. Applications to questions of offtracking (the difference between the trajectories of the front and back wheels of the vehicle) and optimal steering (how to steer around a tight corner) are considered. GRA

88 SPACE SCIENCES (GENERAL)

No abstracts in this category.

89 ASTRONOMY

Includes radio, gamma-ray, and infrared astronomy, and astrometry.

N88-18522 New Hampshire Univ., Durham.
GAMMA-RAY IMAGING OBSERVATIONS OF THE CRAB AND CYGNUS REGIONS Ph.D. Thesis
Mark Lewis McConnell 1987 222 p
Avail: Univ. Microfilms Order No. DA8722436

The results are presented from a balloon borne experiment, referred to as the Directional Gamma Ray Telescope, which is designed to image celestial gamma rays over the energy range 160 keV to 9.3 MeV. It utilizes a technique known as coded aperture imaging in order to obtain spatially resolved images of the sky with an angular resolution of 3.8 deg. This detector is the first flight-ready instrument of this type operating at energies obove 160 keV. During 30 hrs in which the payload remained at float altitude, imaging observations of a number of sky regions were obtained, including observations of the Crab and Cygnus regions. The Crab Nebula was observed to have a featureless powerlaw spectrum with a best fit form of 5.1 x .001 E sub MeV/1.88 photons/sq cm/s/MeV. Emission from Cyg X-1 was observed up to approx. 10 MeV. At energies below 1 MeV, the data are consistent with a single temperature inverse Compton model, with an electron temperature of approx. 80 keV and an optical depth of approx. 2.0. The inverse Compton model is often employed to explain the observed X-ray emission. In the 2 to 9.3 MeV range, the DGT results show emission which is not understood in the context of the inverse Compton model. Dissert. Abstr.

N88-18523*# Jet Propulsion Lab., California Inst. of Tech., Pasadena.
OBSERVATION MODEL AND PARAMETER PARTIALS FOR THE JPL VLBI PARAMETER ESTIMATION SOFTWARE MASTERFIT-1987
O. J. Sovers and J. L. Fanselow 15 Dec. 1987 68 p
(Contract NAS7-918)
(NASA-CR-182524; JPL-Publ-83-39-Rev-3; NAS 1.26:182524)
Avail: NTIS HC A04/MF A01 CSCL 03A

This report is a revision of the document of the same title (1986), dated August 1, which it supersedes. Model changes during 1986 and 1987 included corrections for antenna feed rotation, refraction in modelling antenna axis offsets, and an option to employ improved values of the semiannual and annual nutation amplitudes. Partial derivatives of the observables with respect to an additional parameter (surface temperature) are now available. New versions of two figures representing the geometric delay are incorporated. The expressions for the partial derivatives with respect to the nutation parameters have been corrected to include contributions from the dependence of UTI on nutation. The authors hope to publish revisions of this document in the future, as modeling improvements warrant. Author

N88-18524*# Jet Propulsion Lab., California Inst. of Tech., Pasadena.
DEEP SPACE TARGET LOCATION WITH HUBBLE SPACE TELESCOPE (HST) AND HIPPARCOS DATA
George W. Null 15 Feb. 1988 50 p
(Contract NAS7-918)
(NASA-CR-182520; JPL-Publ-88-4; NAS 1.26:182520) Avail: NTIS HC A03/MF A01 CSCL 03A

Interplanetary spacecraft navigation requires accurate a priori knowledge of target positions. A concept is presented for attaining improved target ephemeris accuracy using two future Earth-orbiting optical observatories, the European Space Agency (ESA) Hipparcos observatory and the Nasa Hubble Space Telescope (HST). Assuming nominal observatory performance, the Hipparcos data reduction will provide an accurate global star catalog, and HST will provide a capability for accurate angular measurements of stars and solar system bodies. The target location concept employs HST to observe solar system bodies relative to Hipparcos catalog stars and to determine the orientation (frame tie) of these stars to compact extragalactic radio sources. The target location process is described, the major error sources discussed, the potential target ephemeris error predicted, and mission applications identified. Preliminary results indicate that ephemeris accuracy comparable to the errors in individual Hipparcos catalog stars may be possible with a more extensive HST observing program. Possible future ground and spacebased replacements for Hipparcos and HST astrometric capabilities are also discussed. Author

90 ASTROPHYSICS

Includes cosmology; celestial mechanics; space plasmas; and interstellar and interplanetary gases and dust.
For related information see also *75 Plasma Physics.*

N88-18525 Max-Planck-Inst. fuer Physik und Astrophysik, Garching (West Germany). Inst. fuer Extraterrestrische Physik.
THE FORMATION OF SINGLE MILLISECOND PULSARS IN GLOBULAR CLUSTERS
F. Verbunt, E. P. J. vandenHeuvel, J. vanParadijs, and S. A. Rappaport (Massachusetts Inst. of Tech., Cambridge.) Aug. 1987 13 p Submitted for publication
(MPE-Preprint-97; ETN-88-91460) Copyright Avail: Issuing Activity

A radio pulsar with a period of 3.054 msec in NGC 6626 (M28) is discussed. The upper limit to the observed period derivative indicates that the pulsar is not in a binary. Millisecond pulsars are probably recycled old pulsars, i.e., spun-up through accretion from a binary stellar companion. In a globular cluster such a binary is likely to form in a tidally dissipative collision between an old neutron star and a low-mass field star from the cluster. A mass-transfer phase ensues and the accretion of only 0.1 solar mass from the companion is sufficient to spin up the neutron star to msec periods. The possibility that accretion from a massive disk is able to directly spin up the neutron star is rejected, since the predicted number of msec pulsars in globular clusters would be 10 times the number of bright low-mass X-ray binaries. In the scenario where the neutron star is spun up in a binary the predicted number of msec pulsars is significantly smaller. If M28 has a magnetic moment similar to that of the 3 other known msec pulsars, the epoch of spin-up terminated less than 800 million years ago. ESA

N88-18526# Gosudarstvennyi Komitet po Ispolzovaniyu Atomnoi Energii, Moscow (USSR).
ONSET OF TYPE 2 SUPERNOVA IN CIRCUMSTELLAR ENVELOPE CREATED BY THE STELLAR WIND FROM PRESUPERNOVA
Eh. K. Grasberg and D. K. Nadezhin 1986 24 p In RUSSIAN
(DE88-700448; ITEF-92-1986) Avail: NTIS (US Sales Only) HC A03/MF A01

The influence of extended circumstellar envelopes on photometric properties and dynamics of type 2 supernovae is investigated. The typical stellar wind of late giants and supergiants (with C sub rho less than or equal to 10/sup 13 g/cm) is shown to have virtually no influence on the supernova light curves. If the mass loss from presupernova is, however, more intensive, the following effects take place: (1) the supernova luminosity increases 1 to 2 magnitudes, but the duration of the light curve plateau remains unchanged; (2) the shape of the light curve is plateau like on the whole, but if the radius of circumstellar envelope is less than approx. 2x10 sup 4 R sub sun, a step (delta 0 approx. 1 to 2 magnitude) on light curve is expected; (3) in the plateau phase of the light curve, the colour index (B-V) may increase steadily in time. For circumstellar envelopes of very high density (C sub rho greater than or approx. 10/sup 17 g/cm), the near-maximum dome may appear on the light curve. The interaction of supernova envelope with stellar wind leads to formation of a thin (spatially but not optically) and dense spherical layer in which true absorption dominates Thompson scattering. DOE

N88-18527 Boston Univ., Mass.
THE ORIGIN OF THE DIFFUSE X-RAY BACKGROUND AND THE FORMATION OF GALAXIES AND VOIDS Ph.D. Thesis
Ruth A. Daly 1987 107 p
Avail: Univ. Microfilms Order No. DA8721316

Considered here is a new paradigm to explain the origin of the diffuse X-ray background and the formation of galaxies and voids. This involves tracing the history of an unstable dark matter candidate. In this model the dark matter and hydrogen form massive, gravitationally bound condensates. The thermal bremsstrahlung emission from the gas in the potential of the dark matter could explain a major fraction of the diffuse X-ray background from 5 to 200 keV. Two other models for evolution of structure in the universe are also described. These do not involve unstable dark matter and may explain both the origin of the diffuse X-ray background and the formation of galaxies and voids.
Dissert. Abstr.

N88-18528 Toledo Univ., Ohio.
A SPHERICAL, NON-LTE, BLANKETED MODEL STELLAR ATMOSPHERE FOR PHI CAS (FOIa) Ph.D. Thesis
Patricia Rosenzweig 1987 196 p
Avail: Univ. Microfilms Order No. DA8722185

By constructing a model atmosphere, the theoretical energy distribution of the emergent radiation that best matches the observed energy distribution of the star Phi Cassiopeiae is calculated; its effective temperature and surface gravity are thus derived. In order to use the pair method to derive the extinction curve for NGC 457 of which Phi Cas is a member, a new method is developed for choosing a lightly reddened comparison star, which consists of matching the equivalent widths of spectral features that are particularly strong and sensitive to temperature and luminosity. The intrinsic energy distribution of Phi Cas was determined from 1500 to 5800 A. A detailed new spherical model atmosphere was constructed. The equation of transfer was solved with the constraints of hydrostatic and pure radiative equilibrium. The statistical equilibrium of 10 to the 6th transitions was treated. Several tests have demonstrated this model to be reliable. Results imply a mass of 6.3 + or - 3.6 solar masses, which agrees with the mass of the main-sequence turnoff of NGC 457.
Dissert. Abstr.

N88-18529# Instituto de Fisica Teorica, Sao Paulo (Brazil).
STELLAR ENERGY LOSS AND ANOMALOUS CONTRIBUTIONS TO THE (PHOTON PHOTON) (NEUTRINO ANTINEUTRINO) INTERACTION
A. A. Natale, V. Pleitez, and A. Tacla 1987 15 p
(DE88-700618; IFT-P-09/87) Avail: NTIS (US Sales Only) HC A03/MF A01

The stellar energy loss rate for several anomalous contributions to the (photon photon) (neutrino antineutrino) and for massive neutrino computed. Except for the cases where the mass scale of these new contributions is very small, or the neutrino masses are very large, these reactions are not important stellar energy loss mechanics. DOE

N88-18530# Lawrence Livermore National Lab., Calif.
CALCULATED LATE TIME SPECTRA OF SUPERNOVAE
T. S. Axelrod 30 Oct. 1987 9 p Presented at the IAU Colloquium No. 108 - Atmospheric Diagnostics of Stellar Evolution: Chemical Peculiarity, Mass Loss, and Explosion, Tokyo, Japan, 1 Sep. 1987
(Contract W-7405-eng-48)
(DE88-003296; UCRL-97699; CONF-8709186-2) Avail: NTIS HC A02/MF A01

We consider here the nebular phase spectra of supernovae whose late time luminosity is provided by the radioactive decay of Ni-56 and Co-56 synthesized in the explosion. A broad variety of supernovae are known or suspected to fall in this category. This includes all SNIa and SNIb, and at least some SNII, in particular SN1987a. At sufficiently late times the expanding supernova becomes basically nebular in character due to its decreasing optical depth. The spectra produced during this stage contain information on the density and abundance structure of the entire supernova, as opposed to spectra near maximum light which are affected only by the outermost layers. A numerical model for nebular spectrum formation is therefore potentially very valuable for answering currently outstanding questions about the post-explosion supernova structure. As an example, we can hope to determine the degree of mixing which occurs between the layers of the onion-skin abundance structure predicted by current one dimensional explosion calculations. In the sections which follow, such a numerical model is briefly described and then applied to SN1972e, a typical SNIa, SN1985f, an SNIb, and finally to SN1987a. In the case of SN1987a, predicted spectra are presented for the

wavelength range from 1 to 100 microns at a time 300 days after explosion. DOE

N88-18531# Fermi National Accelerator Lab., Batavia, Ill.
A LOOK AT SUPERNOVA 1987A
D. N. Schramm Oct. 1987 30 p Presented at the International Symposium on Lepton and Photon Interactions at High Energies, Hamburg, Fed. Republic of Germany, 27 Jul. 1987 Prepared in cooperation with Chicago Univ., Ill.
(Contract DE-AC02-76CH-03000)
(DE88-003411; FNAL/C-87/161-A; CONF-870797-12) Avail: NTIS HC A03/MF A01

Supernova 1987A is reviewed with emphasis on the neutrino observations. It is shown that the results fit well with the expectations for neutrino temperatures (T approx. 4 epsilon sub O and 4.5 MeV) and total energy emitted (2 epsilon sub O and 4 times 10 to the 53rd power ergs). It is argued that the detection tends to favor collapse models that yield emission for 10 second timescales with a 1 epsilon sub O 2 second early accretion phase followed by Kelvin-Helmholtz cooling as opposed to prompt shocks with the immediate onset of cooling. It is also argued that the probable detection of one or more electron scattering event favors a superthermal tail at high energies. Neutrino mass limits and flavor limits are comparable to laboratory experiments. An estimate for future collapse rates in our galaxy of 1/7 year is made based on nucleosynthesis yields. The supernova also has eliminated many axion and majoron models. DOE

N88-18532# Fermi National Accelerator Lab., Batavia, Ill.
HADRON-QUARK PHASE TRANSITION IN DENSE STARS
F. Grassi Oct. 1987 30 p Presented at the Quark Matter '87: 6th International Conference on Ultra-relativistic Nucleus-nucleus Collisions, Schloss Nordkirchen, Fed. Republic of Germany, 1 Aug. 1987
(Contract DE-AC02-76CH-03000)
(DE88-003412; FNAL/C-87/163-A; CONF-8708202-3) Avail: NTIS HC A03/MF A01

An equation of state is computed for a plasma of one flavor quarks interacting through some phenomenological potential, at zero temperature. Assuming that the confining potential is scalar and color-independent, it is shown that the quarks undergo a first-order mass phase transition. In addition, due to the way screening is introduced, all the thermodynamic quantities computed are independent of the actual shape of the interquark potential. This equation of state is then generalized to a several quark flavor plasma and applied to the study of the hadron-quark phase transition inside a neutron star. DOE

N88-18533# Brookhaven National Lab., Upton, N. Y.
SUPERNOVA MECHANISMS: BEFORE AND AFTER SN1987a
S. H. Kahana 1987 10 p Presented at the IAU Colloquium No. 108 - Atmospheric Diagnostics of Stellar Evolution: Chemical Peculiarity, Mass Loss, and Explosion, Tokyo, Japan, 1 Sep. 1987
(Contract DE-AC02-76CH-00016)
(DE88-003489; BNL-40413; CONF-8709186-3) Avail: NTIS HC A02/MF A01

The impact of SN1987a on theoretical studies of the specific mechanism generating Type II supernovae is examined. The explosion energy extracted from analysis of the light curve for SN1987a is on the edge of distinguishing between a prompt explosion from a hydrodynamic shock and a delayed, neutrino-induced, explosion. The detection of neutrinos from 1987a is also reanalyzed. DOE

N88-18534# Fermi National Accelerator Lab., Batavia, Ill.
QUARK MATTER IN ASTROPHYSICS AND COSMOLOGY
A. V. Olinto Oct. 1987 13 p Presented at Quark Matter '87: 6th International Conference on Ultra-Relativistic Nucleus-Nucleus Collisions, Schloss Nordkirchen, Fed. Republic of Germany, 1 Aug. 1987
(Contract DE-AC02-76CH-03000)
(DE88-003406; FNAL/C-87/168-A; CONF-8708202-1) Avail: NTIS HC A03/MF A01

The role of quark matter in astrophysics and cosmology is discussed. The implications of the dynamics of the quark-hadron phase transition in the early universe for the element abundances from big bang nucleosynthesis and the composition of the dark matter in the universe are addressed. We discuss the possibility of deciding on an equation of state for high density matter by observing the cooling of a neutron star remnant of SN1987A. Quark matter models for the Centauros events, Cygnus X-3 cosmic ray events, high energy gamma-ray bursts and the solar neutrino problem are described. DOE

N88-18535# Fermi National Accelerator Lab., Batavia, Ill.
COSMIC STRINGS: A PROBLEM OR A SOLUTION
D. P. Bennett and F. R. Bouchet Oct. 1987 7 p Presented at the NATO ASI: the Post-Recombination Universe, Cambridge, United Kingdom, 27 Jul. 1987 Prepared in cooperation with Chicago Univ., Ill.; California Univ., Berkeley and Lawrence Livermore National Lab., Calif.
(Contract DE-AC02-76CH-03000)
(DE88-003410; FNAL/C-87/164-A; CONF-8707143-1) Avail: NTIS HC A02/MF A01

The most fundamental issue in the theory of cosmic strings is addressed by means of Numerical Simulations: the existence of a scaling solution. The resolution of this question will determine whether cosmic strings can form the basis of an attractive theory of galaxy formation or prove to be a cosmological disaster like magnetic monopoles or domain walls. After a brief discussion of our numerical technique, results are presented which, though still preliminary, offer the best support to date of this scaling hypothesis. DOE

N88-18536# Washington Univ., Seattle. Dept. of Physics.
VELOCITY REVERSAL AND THE ARROWS OF TIME
J. G. Cramer 1987 19 p
(Contract DE-AC06-81ER-40048)
(DE88-004237; DOE/ER-40048/205-L7) Avail: NTIS HC A03/MF A01

A gedankenexperiment is proposed for distinguishing between two models accounting for the macroscopic arrow of time. The experiment involves the velocity reversal of components of an isolated system, and the two models give contrasting predictions as to its behavior. DOE

N88-18537# Los Alamos National Lab., N. Mex.
MEASUREMENTS OF ASTROPHYSICAL REACTION RATES FOR RADIOACTIVE SAMPLES
P. E. Koehler, H. A. OBrien, and C. D. Bowman 1987 11 p Presented at the Workshop on Nuclear Spectroscopy of Astrophysical Sources, Washington, D.C., 14 Dec. 1987
(Contract W-7405-eng-36)
(DE88-004309; LA-UR-87-4104; CONF-871245-2) Avail: NTIS HC A03/MF A01

Reaction rates for both big-bang and stellar nucleosynthesis can be obtained from the measurement of (n,p) and (n,gamma) cross sections for radioactive nuclei. In the past, large backgrounds associated with the sample activity limited these types of measurements to radioisotopes with very long half lives. The advent of the low-energy, high-intensity neutron source at the Los Alamos Neutron Scattering CEnter (LANSCE) has greatly increased the number of nuclei which can be studied. Results of (n,p) measurements on samples with half lives as short as fifty-three days will be given. The astrophysics to be learned from these data will be discussed. Additional difficulties are encountered when making (n,gamma) rather than (n,p) measurements. However, with a properly designed detector, and with the high peak neutron intensities now available, (n,gamma) measurements can be made for nuclei with half lives as short as several weeks. Progress on the Los Alamos (n,gamma) cross-section measurement program for radioactive samples will be discussed. DOE

N88-18538*# Jet Propulsion Lab., California Inst. of Tech., Pasadena.
INTERPLANETARY MISSION DESIGN HANDBOOK. VOLUME 1, PART 5: MARS-TO-EARTH BALLISTIC MISSION OPPORTUNITIES, 1992-2007
Andrey Sergeyevsky and Ross Cunniff 1 Dec. 1987 144 p
(Contract NAS7-918)
(NASA-CR-182525; JPL-Publ-82-43; NAS 1.26:182525) Avail: NTIS HC A07/MF A01 CSCL 03B

This document contains graphical data necessary for the preliminary design of ballistic missions returning from Mars. Contours of Mars-departure energy requirements, as well as many other launch and Earth-arrival parameters are presented in arrival-date/launch-date space for all departure opportunities from 1992 through 2007. In addition, an extensive companion document (Part 2) is available; it contains Earth-Mars graphical data and explains mission design methods, using the graphical data as well as numerous equations relating various parameters. This is one of a planned series of mission design handbooks. Author

91 LUNAR AND PLANETARY EXPLORATION

Includes planetology; and manned and unmanned flights.
For spacecraft design or space stations see *18 Spacecraft Design, Testing and Performance.*

N88-18539 Rice Univ., Houston, Tex.
AN ANALYSIS OF LONGITUDE VARIATIONS IN THE EQUATORIAL SPECTRUM OF SATURN Ph.D. Thesis
Rosemary Margaret Killen 1987 130 p
Avail: Univ. Microfilms Order No. DA8718735

Ground based and Voyager observations in and out of methane and ammonia bands are analyzed to search for longitudinal variations in Saturn's equatorial region. A model with reflecting layer at 2.1 bars, an extended haze to 170 mb and an overlying thin stratospheric haze is adopted. Two sets of data are analyzed, a set of ground based observations covering the 6000 to 6600 A spectral region and a set of Voyager 1 images obtained with the orange and methane filters. The spectral variations are not consistent with a variation in the height of the reflecting layer. They are modeled by variations in the single scattering albedo of the haze and in the specific abundance of gas in the haze. The ground based spectra, having a spatial resolution of 21,000 km are consistent with a specific abundance of gas in the haze of 14 + or - 1 km-amagats per mean free path and a haze single scattering albedo in the continuum at 6055 A of 0.990 with a longitudinal variation of + or - 0.003. The single scattering albedo derived from the ground based observations at 6475 A is 0.993 with a longitudinal variation of + or - .003. The Voyager data are consistent with a specific abundance of gas in the haze between 10b and 24 km-amagats. Dissert. Abstr.

N88-18540*# Atmospheric and Environmental Research, Inc., Cambridge, Mass.
EXTENDED ATMOSPHERES OF OUTER PLANET SATELLITES AND COMETS Interim Report, 15 Jun. - 14 Sep. 1987
William H. Smyth and Michael R. Combi Nov. 1987 122 p
(Contract NASw-3966)
(NASA-CR-181449; NAS 1.26:181449) Avail: NTIS HC A06/MF A01 CSCL 03B

A major model documentation paper for cometary gas coronae and a second paper successfully applied the model to simulate the hydrogen Lyman-alpha coma of comet Kohoutek were completed and are discussed. New and very exciting data for the hydrogen distribution in the Saturn system obtained form earlier unreduced Voyager 1 and Voyager 2 data are preliminarily reviewed. This new data opens up a whole new series of investigations and indicate that Saturn's corona plays a major role in supplying hydrogen to the circumplanetary volume. Author

N88-18541# Los Alamos National Lab., N. Mex.
GAMMA-RAY AND NEUTRON SPECTROSCOPY OF PLANETARY SURFACES AND ATMOSPHERES
R. C. Reedy 1987 9 p Presented at the Workshop on Nuclear Spectroscopy of Astrophysical Sources, Washington, D.C., 14 Dec. 1987
(Contract W-7405-eng-36)
(DE88-004287; LA-UR-87-4199; CONF-871245-1) Avail: NTIS HC A02/MF A01

The neutrons and gamma rays escaping from a planet can be used to map the concentrations of various elements in its surface. In a planet, the high-energy particles in the galactic cosmic rays induce a cascade of particles that includes many neutrons. The gamma rays are made by the decay of the naturally-occurring radioelements and by nuclear excitations induced by cosmic-ray particles and their secondaries (especially neutron capture or inelastic scattering reactions). After a short history of planetary gamma-ray and neutron spectroscopy, the gamma-ray spectrometer and active neutron detection system planned for the Mars Observer Mission are presented. The results of laboratory experiments that simulate the cosmic-ray bombardments of planetary surfaces and the status of the theoretical calculations for the processes that make and transport neutrons and gamma rays will be reviewed. Studies of Mars, including its atmosphere, are emphasized, as are new ideas, concepts, and problems that have arisen over the last decade, such as Doppler broadening and peaks from neutron scattering with germanium nuclei in a gamma-ray spectrometer. DOE

92 SOLAR PHYSICS

Includes solar activity, solar flares, solar radiation and sunspots.
For related information see *93 Space Radiation.*

N88-18542# Gosudarstvennyi Komitet po Ispolzovaniyu Atomnoi Energii, Moscow (USSR). Inst. Teoreticheskoj i Ehksperimental'noj Fiziki.
NEUTRINO MAGNETIC MOMENT AND TIME VARIATION OF SOLAR NEUTRINO FLUX
M. B. Voloshin and M. I. Vysotskij 1986 4 p
(DE88-700687; ITEP-1(1986)) Avail: NTIS (US Sales Only) HC A02/MF A01

An explanation is proposed of a possible anticorrelation of the observed neutrino flux from the Sun with the solar activity due to the existance of the neutrino magnetic moment mu approx. (0.3-1)x10/sup -10/ mu/sub B/, resulting in a partial flip of neutrino helicity during the flight through the magnetic field of the solar convective zone. DOE

N88-18543# Los Alamos National Lab., N. Mex.
PERSONAL OVERVIEW OF SOLAR WIND 6
J. T. Gosling 1987 8 p Presented at the 6th Meeting of Solar Wind, Estes Park, Colo., 24 Aug. 1987
(Contract W-7405-eng-36)
(DE88-003147; LA-UR-87-3998; CONF-8708141-6) Avail: NTIS HC A02/MF A01

Papers presented at the Solar Wind 6 Proceedings are reviewed. The particular topics discussed are solar wind acceleration theory, heliosphere production of solar winds, coronal mass ejections, interplanetary shock disturbance, and solar wind ionic composition. A concern for the steady decline in solar wind observations is expressed. Author

N88-18544# National Geophysical Data Center, Boulder, Colo.
SOLAR-GEOPHYSICAL DATA NUMBER 517, SEPTEMBER 1987. PART 1: (PROMPT REPORTS). DATA FOR AUGUST, JULY 1987 AND LATE DATA
Helen E. Coffey, ed. and John A. McKinnon, ed. Sep. 1987 118 p
(Contract N00014-86-F-0049)

(PB88-128426; SGD-517-Pt-1; ISSN-0038-0911; LC-79-640375)
Avail: NTIS HC A06/MF A01 CSCL 03B

Solar/geophysical information is presented in index form. Categories include detailed index for 1986 to 1987; Data for August 1987 (IUWDS alert periods (advance and worldwide), Solar activity indices, Solar flares, Solar radio emission, Stanford mean solar magnetic field); Data for July 1987 (Solar active regions, Sudden ionospheric disturbances, Solar radio spectral observations, Cosmic ray measurements by neutron monitor, Geomagnetic indices, Radio propagation indices); Late data (Solar radio emission July 1987, Pioneer XII interplanetary magnetic field magnitudes, Cosmic ray neutron monitor Thule June 1987, Geomagnetic indices, Calcium plage data December 1986 through January 1987). E.R.

N88-18545# National Geophysical Data Center, Boulder, Colo.
SOLAR-GEOPHYSICAL DATA NUMBER 517, SEPTEMBER 1987. PART 2: (COMPREHENSIVE REPORTS). DATA FOR MARCH 1987 AND MISCELLANEA
Helen E. Coffey, ed. and John A. McKinnon, ed. Sep. 1987 39 p
(Contract N00014-86-F-0049)
(PB88-128434; SGD-517-Pt-2; ISSN-0038-0911; LC-79-640375)
Avail: NTIS HC A03/MF A01 CSCL 03B

Solar/geophysical information is presented in index form. Categories include detailed index for 1986 to 1987: Data for March 1987 (Meudon carte synoptique, Solar flares, Solar radio bursts at fixed frequencies, Solar X-ray radiation from GOES satellite, Mass ejection from the sun, Active prominences and filaments). Miscellaneous data include: Mass ejections from the sun February 1987, Interplanetary solar wind IMP 8. E.R.

N88-18546# California Inst. of Tech., Pasadena.
THE RELATION OF SOLAR WIND STRUCTURE TO HYDROMAGNETIC DISCONTINUITIES
C. J. Alexander, M. Neugebauer, E. J. Smith, and S. J. Bame (Los Alamos National Lab., N. Mex.) 1987 6 p Presented at the 6th Meeting of Solar Wind, Estes Park, Colo., 24-28 Aug. 1987
(Contract W-7405-eng-36)
(DE88-004304; LA-UR-87-4159; CONF-8708141-7) Avail: NTIS HC A02

High resolution ISEE-3 data have been used to examine the relative abundances of tangential (TD) vs rotational (RD) discontinuities in different types of solar wind flow. Three types of flow were examined; flow from coronal holes, sector boundary flow and transient flow. It has been found that coronal hole flow has substantially more discontinuities and a greater ratio of RD's to TD's than do the other types of flow. Discontinuities are least frequent in transient flows characterized by bidirectional streaming of electrons. This leads to the conclusion that meaningful studies of the velocity dependence of the rates of occurrence of different types of discontinuities must take the type of flow (coronal hole versus transient) into account. DOE

93 SPACE RADIATION

Includes cosmic radiation; and inner and outer earth's radiation belts.

For biological effects of radiation see *52 Aerospace Medicine*. For theory see *73 Nuclear and High-Energy Physics*.

N88-18547# Gosudarstvennyj Komitet po Ispolzovaniyu Atomnoi Energii, Serpukhov (USSR). Inst. Fiziki Vysokikh Ehnergij.
ON THE TIME DELAY OF THE ULTRAHIGH-ENERGY RADIATION SIGNAL FROM THE SOURCE CYGNUS X-3
B. A. Arbuzov and E. A. Razuvaev 1986 4 p
(DE88-700649; IFVE-OTF-86-207) Avail: NTIS (US Sales Only) HC A02/MF A01

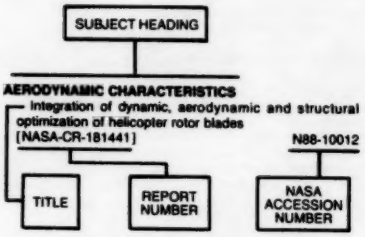
The time delay of the signal from the source Cygnus X-3 detected by EAS observation with E greater than or equal to 3x10/sup 14/ eV and counted off the maximum of radioburst in October, 1985 is considered. The effect is shown to get the explanation in the framework of the earlier proposed interpretation of the ulrahigh-energy radiation as free gluons. The agreement of this interpretation with the totality of experimental data is emphasized. A possibility of relict gluons to give a significant contribution to the density of a hidden mass in the Universe is discussed. DOE

99 GENERAL

N88-18548*# National Aeronautics and Space Administration. John F. Kennedy Space Center, Cocoa Beach, Fla.
RESEARCH AND TECHNOLOGY 1987 ANNUAL REPORT OF THE KENNEDY SPACE CENTER
Dec. 1987 72 p
(NASA-TM-100303; NAS 1.15:100303) Avail: NTIS HC A04/MF A01 CSCL 05D

As the NASA Center responsible for assembly, checkout, servicing, launch, recovery, and operational support of Space Transportation System elements and payloads, Kennedy Space Center is placing increasing emphasis on the Center's research and technology program. In addition to strengthening those areas of engineering and operations technology that contribute to safer, more efficient, and more economical execution of our current mission, we are developing the technological tools needed to execute the Center's mission relative to future programs. The Engineering Development Directorate encompasses most of the laboratories and other Center resources that are key elements of research and technology program implementation, and is responsible for implementation of the majority of the projects of this Kennedy Space Center 1987 Annual Report. Author

Typical Subject Index Listing



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A

A-300 AIRCRAFT
The European Airbus A-300 N88-17824

ABSOLUTE ZERO
Zero temperature quark matter equation of state
[DE88-003408] N88-18496

ABSORPTION CROSS SECTIONS
Absolute rate measurements of two-photon process of gases, liquids, and solids
[DE88-003800] N88-18391

ABSORPTION SPECTRA
Guided-wave approaches to spectrally selective energy absorption
[NASA-CR-182532] N88-17892
Absolute rate measurements of two-photon process of gases, liquids, and solids
[DE88-003800] N88-18391

ABSORPTION SPECTROSCOPY
Energy transfer studies with lasers
[DE88-004864] N88-17991

ABSORPTIVITY
Effect of translucence of engineering ceramics on heat transfer in diesel engines
[DE88-003732] N88-17804

ACCELERATION TOLERANCE
Improvement of human tolerance to head-pelvis (+Gz) accelerations by increasing hydration N88-18153
Effect of cardioactive compounds on rat myocardium actomyosin following exposure to accelerations N88-18161

ACCELEROMETERS
Strategic placement of accelerometers to measure forces by the sum of weighted accelerations
[DE88-002262] N88-17968

ACCIDENT INVESTIGATION
Aircraft accident/incident, Newark, New Jersey, November 13, 1986
[NTSB/AAR-87/04-SUMM] N88-17639

ACCURACY
On precision and accuracy (bias) statements for measurement procedures
[DE88-004434] N88-18359

ACOUSTIC ATTENUATION
Silencium resonators (Silators) for the attenuation and elimination of sound
[MBB-Z-546/83] N88-17841

ACOUSTIC EMISSION
Acoustic emission-microstructural relations in ferritic steels. Part 3: The effect of inclusion content
[AERE-R-12041] N88-18015
Acoustic emission measurements of PWR weld materials with inserted defects
[AERE-R-12386] N88-18016
Institute for Materials Science and Engineering, nondestructive evaluation: Technical activities 1987
[PB88-153655] N88-18020

ACOUSTIC MICROSCOPES
Cryogenic acoustic microscopy
[AD-A187274] N88-17767

ACOUSTIC SCATTERING
Scattering of impulsive acoustic waves by a semi-infinite crack in the plane interface of a half-space and a layer
[PB88-126396] N88-18377
Inversion of parabolic and paraboloidal projections
[AD-A187538] N88-18380

ACOUSTIC VELOCITY
A modified version of the phase sensitive technique for measurements of absolute sound velocity in solids
[DE88-002303] N88-18378

ACOUSTICS
Speech recognition: Acoustic-phonetic knowledge acquisition and representation
[AD-A187293] N88-17893

ACTIVATION ENERGY
Insights into the mechanisms of chemical reactions: Reaction paths for chemical reactions
[DE88-003041] N88-17755
Diffusion studies in amorphous NiZr alloys
[DE88-003009] N88-17781

ACTIVE CONTROL
Sensitivity of active vibration control to structural changes and model reduction N88-17683
Active control technology with adaptive control concept in the aircraft construction
[MBB/LKE-294/S/PUB/295] N88-17845

ADA (PROGRAMMING LANGUAGE)
Factors causing unexpected variations in Ada benchmarks
[AD-A187231] N88-18291

ADAPTATION
Physiological and ecological implications of coupled heat- and water-transport mechanisms of endotherms and vegetation
[DE88-004170] N88-18081
Polar worker adaptability to Antarctic high altitudes N88-18165
NASA Workshop on Biological Adaptation
[NASA-TM-89468] N88-18174
Analysis and synthesis of adaptive neural elements
[AD-A187047] N88-18316

ADAPTIVE CONTROL
Systolic array adaptive beamforming
[AD-A187496] N88-18269

ADAPTIVE FILTERS
An adaptive filtering technique for removing periodic noise from modal response data
[DE88-002347] N88-17903

ADENOSINE TRIPHOSPHATE
Myosin Ca sup (2+), Mg sup (2+)-adenosine triphosphatase activity in ray myocardium following 30-day expose to 1.1 and 2.0 G N88-18141

ADHESION
Adhesion, friction and micromechanical properties of ceramics
[NASA-TM-100782] N88-17801
Adhesion of vapour phase deposited ultra-thin polyimide films on polycrystalline silver
[AD-A187930] N88-17810

ADHESIVE BONDING
A finite element analysis of adhesively bonded composite joints including geometric nonlinearity, nonlinear viscoelasticity moisture diffusion and delayed failure
[AD-A187455] N88-17747
The effect on initial bond strength and durability of a Phosphoric Acid Dip (PAD) following chromic acid anodising of aluminum
[ARE-TM(UMM)-87402] N88-17772
New scientific findings on the morphology of aluminum oxide layers, serving as an adhesive basis
[MBB-Z-137/86] N88-17840
Theoretical analysis of adhesive fracture and crack-damage interactions N88-18030

ADJUSTING
Possibilities for on-line surge suppression by fast guide vane adjustment in axial compressors N88-17674

ADRENAL GLAND
Effect of external electrostatic field on catecholamine secretion by rat adrenals N88-18166

ADVECTION
A study of numerical methods for hyperbolic conservation laws with stiff source terms
[NASA-TM-100075] N88-18343

AERIAL RECONNAISSANCE
Earth resources: A continuing bibliography with indexes (supplement 56)
[NASA-SP-7041(56)] N88-18051

AEROBIOLOGY
Project Explorer takes its second step: GAS-608 in engineering development N88-17707

AERODYNAMIC CHARACTERISTICS
Calculation of aerodynamic characteristics of airplane configurations at high angles of attack
[NASA-CR-182541] N88-17612
Investigation of the influence of wind shear on the aerodynamic characteristics of aircraft using a vortex-lattice method N88-17619

AERODYNAMIC COEFFICIENTS
Investigation of the influence of wind shear on the aerodynamic characteristics of aircraft using a vortex-lattice method N88-17619

AERODYNAMIC CONFIGURATIONS
Burst vortex/boundary layer interaction
[NASA-CR-182510] N88-17583
The intelligent wing. Aerodynamic development direction for future passenger aircraft
[MBB-UT-006/87] N88-17848
Aerodynamic aspects of the configurational systems layout of a dispenser
[MBB-UA-1047/87] N88-17863

AERODYNAMIC DRAG
Wind tunnel studies of circulation control elliptical airfoils N88-17598
Preliminary design of the ORION attitude control system
[AD-A187179] N88-17729
Determination of the drag of missiles with variable lateral acceleration possibility
[REPT-FM15] N88-17831

AERODYNAMIC HEATING
High-temperature properties of ceramic fibers and insulations for thermal protection of atmospheric entry and hypersonic cruise vehicles
[NASA-TM-100059] N88-17743

AERODYNAMIC INTERFERENCE
Determination of the drag of missiles with variable lateral acceleration possibility
[REPT-FM15] N88-17831

AERODYNAMIC LOADS
X-wing potential for Navy applications N88-17604

AERODYNAMIC STABILITY
Flap-lag-torsion aeroelastic stability of a circulation control rotor in forward flight N88-17600
An application of eigenspace methods to symmetric flutter suppression
[NASA-CR-181618] N88-17684
Special flight mechanical features of the bearingless helicopter rotor
[MBB-FM-315/O] N88-17825

AERODYNAMIC STALLING
Investigation of dynamic stall using LDV (Laser Doppler Velocimetry): Mean flow studies
[AD-A187629] N88-17611
AERODYNAMICS
Application of empirical and linear methods to VSTOL powered-lift aerodynamics
[NASA-TM-100048] N88-17581
Fixed wing CCW aerodynamics with and without supplementary thrust deflection N88-17607
Supersonic aerodynamics of delta wings
[NASA-TP-2771] N88-17615
A research program on the aerodynamics of a highly loaded turbine stage N88-17655
Design and aerodynamic performance of a small mixed-flow gas generator turbine N88-17662
Aerodynamic performance of a scale-model, counter-rotating unducted fan N88-17666
Numerical methods for propeller aerodynamics and acoustics at DFVLR N88-17668
Analysis of highspeed propellers aerodynamics N88-17669
AEROELASTICITY
Flap-lag-torsion aeroelastic stability of a circulation control rotor in forward flight N88-17600
Prediction of aeroelastic response of a model X-wing rotor N88-17603
Using frequency-domain methods to identify XV-15 aeroelastic modes
[NASA-TM-100033] N88-17648
The application of modern aeroelastic developments for future projects
[MBB-UT-007/87] N88-17850
Vibration and flutter characteristics of the SR7L large-scale propfan
[NASA-TM-100272] N88-18036
AEROSOLS
Meteorological and aerosol measurements from the NOAA WP-3D aircraft during WATOX-86, January 4-9, 1986
[PB88-120860] N88-18079
AEROSPACE ENGINEERING
Environment assisted degradation mechanisms in aluminum-lithium alloys
[NASA-CR-182482] N88-17782
Messerschmitt-Boelkow-Blohm: A company with a tradition N88-17866
AEROSPACE ENVIRONMENTS
Space station integrated wall damage and penetration damage control. Task 5: Space debris measurement, mapping and characterization system
[NASA-CR-179281] N88-17688
USSR Space Life Sciences Digest, issue 15
[NASA-CR-3922(18)] N88-18175
AEROSPACE INDUSTRY
Research, development, and growth strategy N88-17820
Cooperation know-how in high-tech products
[MBB-Z-101/86] N88-17833
The prospects of space utilization
[MBB-UR-931/86] N88-17856
Messerschmitt-Boelkow-Blohm: A company with a tradition N88-17866
Messerschmitt-Boelkow-Blohm: Biography and history of a company N88-17867
Messerschmitt-Boelkow-Blohm, the company today. Data, numbers and facts N88-17868
JPRS report: Science and Technology. Europe and Latin America
[JPRS-ELS-88-002] N88-17870
A comparison of projection methods in the forecasting of overhead costs for seven government aerospace contractors
[AD-A187572] N88-18514
AEROSPACE MEDICINE
JPRS Report: Science and Technology. USSR: Space Biology and Aerospace Medicine, volume 21, no. 5, September - October 1987
[JPRS-USB-88-003] N88-18122
Medical and psychological problems of assuring flight safety under present conditions N88-18123
Isotope methods of determining distribution and movement of blood in the body N88-18138
Discrete adaptation to sensory conflict N88-18146
JPRS Report: Science and Technology. USSR: Space Biology and Aerospace Medicine, volume 21, no. 6, November - December 1987
[JPRS-USB-88-004] N88-18150
Present stage of space medicine N88-18151
Improvement of human tolerance to head-pelvis (+Gz) accelerations by increasing hydration N88-18153
Aerospace medicine and biology: A cumulative index to a continuing bibliography (supplement 306)
[NASA-SP-7011(306)] N88-18180
Aerospace medicine and biology: A continuing bibliography with indexes (supplement 308)
[NASA-SP-7011(308)] N88-18183
AEROSPACE TECHNOLOGY TRANSFER
Cooperation know-how in high-tech products
[MBB-Z-101/86] N88-17833
AGE FACTOR
Drosophila geotaxis as a tool for the study of aging N88-17706
AGING (BIOLOGY)
Drosophila geotaxis as a tool for the study of aging N88-17706
AGING (MATERIALS)
Evaluation of bituminous materials used in pavement recycling projects at Tyndall, MacDill, and Hurlburt Air Force Bases
[AD-A188068] N88-17871
AGING (METALLURGY)
Effect of low-temperature aging on the mechanical properties of cast stainless steels
[DE88-002872] N88-17774
AIR
NF85: A three-dimensional, air-dynamics computer code for analyzing explosions in structures
[DE88-005085] N88-17953
AIR CONDITIONING
Research on fluid dynamic energy separation
[DE88-002776] N88-18001
AIR CONDITIONING EQUIPMENT
Experimental studies of heat and mass exchange in parallel-passage rotary desiccant dehumidifiers for solar cooling applications
[DE88-001119] N88-18069
AIR POLLUTION
The role of repowering in America's power generation future
[DOE/FE-0096] N88-18078
Meteorological and aerosol measurements from the NOAA WP-3D aircraft during WATOX-86, January 4-9, 1986
[PB88-120860] N88-18079
The role of analytical chemistry in assessing atmospheric effects of combustion
[DE88-003909] N88-18082
Developments in National Weather Service meteorological data collection programs as related to EPA (Environmetal Protection Agency) air pollution models
[PB88-130240] N88-18104
Using SIR (Scientific Information Retrival) system for data management during a field program
[DE88-001555] N88-18508
AIR QUALITY
Evaluation of regional-scale air quality models: Chairmen reports from four workshops
[DE88-001397] N88-18080
Tropospheric ultraviolet radiation: Assessment of existing data and effect on ozone formation
[PB88-130133] N88-18095
AIR WATER INTERACTIONS
NASA Oceanic Processes Program
[NASA-TM-4025] N88-18109
Numerical simulations of the California current: Filament formation as related to baroclinic instability
[AD-A187573] N88-18115
On the barotropic model of the ocean circulation
[AD-A188148] N88-18118
AIRBORNE EQUIPMENT
Airborne Wind Shear Detection and Warning Systems: First Combined Manufacturers' and Technologists' Conference
[NASA-CP-10006] N88-17616
Airborne Doppler lidar detection of wind shear. Results of performance analysis N88-17627
Forward looking wind shear detection N88-17629
Crew interface with windshear systems N88-17631
AIRBORNE/SPACEBORNE COMPUTERS
Airworthiness considerations N88-17636
An expert system to support the verification/validation of flight-critical software
[MBB-UT-102/87] N88-17852
AIRCRAFT ACCIDENTS
Annual review of aircraft accident data: US air carrier operations calendar year 1985
[PB88-135843] N88-17638
Aircraft accident/incident, Newark, New Jersey, November 13, 1986
[NTSB/AAR-87/04-SUMM] N88-17639
AIRCRAFT COMMUNICATION
Information transfer in the National Airspace System N88-17634
AIRCRAFT CONFIGURATIONS
Calculation of aerodynamic characteristics of airplane configurations at high angles of attack
[NASA-CR-182541] N88-17612
An examination of the impact of potential advances in component technology for future military engines N88-17650
AIRCRAFT CONSTRUCTION MATERIALS
Effects of aviation fluids on carbon fibre composite material
[PB88-127857] N88-17740
Modern materials for light constructions --- aircraft
[MBB-Z-136/86] N88-17839
AIRCRAFT CONTROL
Proceedings of the Circulation-Control Workshop, 1986
[NASA-CP-2432] N88-17586
The impact of circulation control on rotary aircraft controls systems N88-17601
A potential flight evaluation of an upper-surface-blowing/circulation-control-wing concept N88-17609
Airborne Wind Shear Detection and Warning Systems: First Combined Manufacturers' and Technologists' Conference
[NASA-CP-10006] N88-17616
Investigation of the influence of wind shear on the aerodynamic characteristics of aircraft using a vortex-lattice method N88-17619
Simulator investigation of wind shear recovery techniques N88-17630
Active control technology with adaptive control concept in the aircraft construction
[MBB/LKE-294/S/PUB/295] N88-17845
AIRCRAFT DESIGN
Development of vertical takeoff aircraft with turbojet engines in Germany N88-17822
Variable sweep wings N88-17823
The European Airbus A-300 N88-17824
Purposes and tasks of high-performance aircraft construction
[MBB/LK-S/PUB/296] N88-17842
AIRCRAFT ENGINES
Advanced Technology for Aero Gas Turbine Components
[AGARD-CP-421] N88-17647
The coming revolution in turbine engine technology N88-17648
Optimisation of military compressors for weight and volume N88-17649
An examination of the impact of potential advances in component technology for future military engines N88-17650
Specification of an engine and its components starting from a consideration of aircraft missions N88-17651
Application of highly loaded single-stage mixed-flow compressors in small jet-engines N88-17652
A research program on the aerodynamics of a highly loaded turbine stage N88-17655
Design and aerodynamic performance of a small mixed-flow gas generator turbine N88-17662
Development of a plenum chamber burner system for an advanced VTOL engine N88-17664
Aerodynamic performance of a scale-model, counter-rotating unducted fan N88-17666
Gear systems for advanced turboprops N88-17667
Ceramic bearings for use in gas turbine engines
[NASA-TM-100288] N88-18007
AIRCRAFT EQUIPMENT
Information transfer in the National Airspace System N88-17634
AIRCRAFT FUEL SYSTEMS
Pumping systems and flow interfaces for rapid response electronic reheat controls N88-17665
AIRCRAFT GUIDANCE
Simulator investigation of wind shear recovery techniques N88-17630
Airworthiness considerations N88-17636
AIRCRAFT HAZARDS
NASA wind shear model: Summary of model analyses N88-17617
Response of wind shear warning systems to turbulence with implication of nuisance alerts N88-17618
Forward looking wind shear detection N88-17629
Crew interface with windshear systems N88-17631
AIRCRAFT INDUSTRY
Purposes and tasks of high-performance aircraft construction
[MBB/LK-S/PUB/296] N88-17842
AIRCRAFT MANEUVERS
Future fighter maneuverability for air combat
[MBB/LKE-1/S/PUB/120] N88-17843
AIRCRAFT NOISE
Supersonic and subsonic aircraft noise effects on animals: A literature survey
[AD-A186922] N88-18373
Sound transmission through the walls of light aircraft: An investigation of structure-borne noise in a Handley Page 137 Jetstream 3 aircraft
[NASA-CR-182509] N88-18376

AIRCRAFT PERFORMANCE
Development of vertical takeoff aircraft with turbojet engines in Germany N88-17622
Variable sweep wings N88-17823
Purposes and tasks of high-performance aircraft construction
[MBB/LK-S/PUB/296] N88-17842
Flight testing of fighter aircraft
[MBB/LKE-62/S/PUB/292] N88-17844
AIRCRAFT PILOTS
Crew interface with windshear systems N88-17631
Trends in the distribution of tasks between commercial pilots and flight control systems
[MBB-UT-008/87] N88-17851
AIRCRAFT PRODUCTION
Product planning in civil aircraft construction
[MBB-UT-002/87] N88-17849
The application of modern aeroelastic developments for future projects
[MBB-UT-007/87] N88-17850
AIRCRAFT PRODUCTION COSTS
Product planning in civil aircraft construction
[MBB-UT-002/87] N88-17849
AIRCRAFT RELIABILITY
Airworthiness considerations N88-17636
AIRCRAFT SAFETY
Annual review of aircraft accident data: US air carrier operations calendar year 1985
[PB88-135843] N88-17638
Aircraft accident/incident, Newark, New Jersey, November 13, 1986
[NTSB/AAR-87/04-SUMM] N88-17639
AIRCRAFT SPECIFICATIONS
The European Airbus A-300 N88-17824
AIRCRAFT STRUCTURES
Modern materials for light constructions — aircraft
[MBB-Z-136/86] N88-17839
Purposes and tasks of high-performance aircraft construction
[MBB/LK-S/PUB/296] N88-17842
The application of modern aeroelastic developments for future projects
[MBB-UT-007/87] N88-17850
Sound transmission through the walls of light aircraft: An investigation of structure-borne noise in a Handley Page 137 Jetstream 3 aircraft
[NASA-CR-182509] N88-18376
AIRFOIL PROFILES
The further development of circulation control airfoils N88-17594
Circulation control STOL aircraft design aspects N88-17610
AIRFOILS
Well-posedness and spectral estimation for infinite dimensional systems
[AD-A187621] N88-18354
AIRFRAMES
Durability and damage tolerance of aluminum castings
[AD-A186444] N88-18013
AIRLINE OPERATIONS
Annual review of aircraft accident data: US air carrier operations calendar year 1985
[PB88-135843] N88-17638
AIRPORTS
NASA wind shear model: Summary of model analyses N88-17617
Radar backscatter from airports and surrounding areas N88-17623
Radar returns from ground clutter in vicinity of airports N88-17624
Status of FAA terminal Doppler weather radar programs N88-17632
The advanced low-level windshear alert system operational demonstration results, Summer, 1987, Denver Stapleton International Airport N88-17633
Evaluation of bituminous materials used in pavement recycling projects at Tyndall, MacDill, and Hurlburt Air Force Bases
[AD-A188068] N88-17871
AIRSPACE
Information transfer in the National Airspace System N88-17634
ALEUTIAN ISLANDS (US)
Geological evolution and analysis of confirmed or suspected gas hydrate localities. Volume 10: Basin analysis, formation and stability of gas hydrates of the Aleutian Trench and the Bering Sea
[DE88-001008] N88-18048
ALGAE
Research on a solar biotechnology based on the culture of photosynthetic cells
[DE88-900129] N88-18120
ALGEBRA
An applicative programmer's approach to matrix algebra, lessons for hardware and software N88-18251
The impact of hierarchical memory systems on linear algebra algorithm design
[DE88-003574] N88-18274
Programming methodology and performance issues for advanced computer architectures
[DE88-003098] N88-18287
Leapfrog variants of iterative methods for linear algebra equations
[NASA-CR-181616] N88-18332
Vector bundles over real algebraic varieties
[PB88-126677] N88-18335
ALGORITHMS
Navier-Stokes simulation of wind-tunnel flow using LU-ADI factorization algorithm
[NASA-TM-100042] N88-17584
Formulation methods of rigid multibody systems for large space structures and some results of computer simulation
[NAL-TR-942] N88-17730
Designing variable-length codes with good error-recovery properties
[BBC-RD-1987/19] N88-17876
Recursive forward dynamics for multiple robot arms moving a common task object
[NASA-CR-182526] N88-18008
The arithmetic cube and its associated algorithms N88-18195
Hardware implementation for special functions. An application for combat simulation N88-18197
Role of broadcasting in multiprocessor systems N88-18201
The mapping of parallel algorithms to reconfigurable parallel architectures N88-18209
A comparative study of heurstic algorithms for task assignment in distributed computing systems N88-18211
Distributed control of large parallel computers N88-18215
Strategies for concurrent processing of complex algorithms N88-18236
Investigations on the usefulness of the Massively Parallel Processor for study of electronic properties of atomic and condensed matter systems
[NASA-CR-182514] N88-18259
Parameter identification and sensitivity analysis for a robotic manipulator arm
[NASA-CR-181608] N88-18272
The impact of hierarchical memory systems on linear algebra algorithm design
[DE88-003574] N88-18274
PSolve: A concurrent algorithm for solving sparse systems of linear equations
[DE88-003584] N88-18275
Introduction to a system for implementing neural net connections on SIMD architectures
[NASA-CR-181612] N88-18279
Graph transformation algorithms for array memory optimization in applicative languages
[DE88-004727] N88-18283
Non-mythical generalization of Dekker's algorithm and its ramifications
[PB88-126321] N88-18285
Experiences with serial and parallel algorithms for channel routing using simulated annealing
[NASA-CR-182530] N88-18289
Semantics of EqL
[AD-A188151] N88-18297
Implementation and analysis of a Navier-Stokes algorithm on parallel computers
[NASA-CR-181614] N88-18301
A parallel quasi-Newton method for partially separable large scale minimization
[DE88-003592] N88-18309
Performance studies of a parallel processor for large linear programming problems
[PB88-121611] N88-18310
Application of a multigrid method to a buoyancy-induced flow problem
[DE88-003961] N88-18326
Quasigroup approach to solution of linear algebraic equation systems
[DE88-700595] N88-18330
Straightening and the Stanley decomposition for the (2;n)-nilpotent vectorfield
[PB88-126685] N88-18336
The hybrid Monte Carlo Algorithm and the chiral transition
[DE88-004305] N88-18341
ALKALIES
Mechanisms of intergranular attack and stress corrosion cracking of alloy 600 by high-temperature caustic solutions containing impurities
[DE87-012820] N88-17773
The band systems of alkali vapors
[NASA-TT-20206] N88-18462
ALKENES
Chemical activation of molecules by metals: Experimental studies of electron distributions and bonding
[DE88-004465] N88-18393
ALL-WEATHER AIR NAVIGATION
Rotor SAR (ROSAR): A new high-resolution all-weather vision method for helicopters
[MBB-UA-1046/87] N88-17855
ALLOYS
Mechanisms of intergranular attack and stress corrosion cracking of alloy 600 by high-temperature caustic solutions containing impurities
[DE87-012820] N88-17773
Transmission electron microscopy studies of titanium-containing braze/alumina seals
[DE88-005243] N88-17792
Strength and structure of Ga sub 1-xIn sub xAs alloys
[AD-A188092] N88-17795
Electronic structure of random alloys and the theory of ordering processes
[DE88-004476] N88-18394
Tight binding theory of semiconductors N88-18447
ALTERNATING CURRENT
Application of ac-impedance method on determination of corrosion rate of metals
[DE88-750307] N88-17771
ALTITUDE CONTROL
Magnetic emissions testing of the space station engineering model resistojet
[NASA-TM-100788] N88-17728
ALTITUDE SIMULATION
Experimental evaluation of turning vane designs for high-speed and coupled fan-drive corners of 0.1-scale model of NASA Lewis Research Center's proposed altitude wind tunnel
[NASA-TP-2681] N88-17686
ALUMINUM
The effect on initial bond strength and durability of a Phosphoric Acid Dip (PAD) following chromic acid anodising of aluminum
[ARE-TM(UMM)-87402] N88-17772
Investigation of materials for inert electrodes in aluminum electrodeposition cells
[DE88-003380] N88-17906
Strategic placement of accelerometers to measure forces by the sum of weighted accelerations
[DE88-002262] N88-17968
Durability and damage tolerance of aluminum castings
[AD-A186444] N88-18013
ALUMINUM ALLOYS
Micro-mechanisms of deformation in SiC/Al composites
[AD-A188282] N88-17749
Environment assisted degradation mechanisms in aluminum-lithium alloys
[NASA-CR-182482] N88-17782
Corrosion behavior of sputter-deposited aluminum-based alloys exposed to chloride solutions
[AD-A187262] N88-17794
ALUMINUM BORON COMPOSITES
Analytical and experimental characterization of damage processes in composite laminates
[AD-A187221] N88-17746
ALUMINUM OXIDES
The influence of the heating procedure on the oxidation behaviour of NiAl studied by XPS
[AERE-R-12498] N88-17776
The migration of grain boundaries in ceramic materials with particular reference to the sintering process
[DE88-004085] N88-17808
New scientific findings on the morphology of aluminum oxide layers, serving as an adhesive basis
[MBB-Z-137/86] N88-17840
The soft/hard wet anodization of aluminum oxide and its use in a thin film multilayered capacitor
[AD-A187575] N88-17919
AMBIENT TEMPERATURE
GAS eleven node thermal model (GEM) N88-17712
AMMONIA
Human blood glutamic acid level with exposure to high ambient concentrations of ammonia N88-18134
AMMONIUM NITRATES
An infra-red investigation of HAN (Hydroxylammonium Nitrate)-based liquid propellants
[AD-A187226] N88-17815
AMMUNITION
Dependence of the expectancy of hitting on the number of spread shots. Determination of the expectancy of hitting using a spread salvo
[REPT-FM6] N88-17829
AMORPHOUS MATERIALS
Diffusion studies in amorphous NiZr alloys
[DE88-003009] N88-17781

The soft/hard wet anodization of aluminum oxide and its use in a thin film multilayered capacitor
[AD-A187575] N88-17919

AMPLIFICATION

Signal processing studies program optical signal amplification, volume 2
[AD-A188054] N88-17896

Signal processing studies program optical signal amplification, volume 1
[AD-A188055] N88-17897

AMPLIFIERS

Conceptual designs of a 50 NM FEL (Free-Electron Laser) oscillator and a 20-40 NM SASE (Self-Amplified Spontaneous Emission) amplifier
[DE88-003150] N88-17974

New generation imager system
[NASA-CR-180464] N88-18398

ANALYSIS (MATHEMATICS)

The mathematization of the military sciences
[MBB-Z-139/87] N88-17834

ANALYSIS OF VARIANCE

Annotated computer output for split plot design: GENSTAT ANOVA
[AD-A187120] N88-18271

ANGLE OF ATTACK

Calculation of aerodynamic characteristics of airplane configurations at high angles of attack
[NASA-CR-182541] N88-17812

ANGULAR MOMENTUM

Application of state-multipole Heisenberg equations to Raman excitation dynamics
[DE88-003828] N88-17977

State-to-state dynamics of molecular energy transfer
[DE88-003282] N88-18382

Positron-annihilation 2D-ACAR studies of disordered and defected alloys
[DE88-003118] N88-18454

ANIMALS

Supersonic and subsonic aircraft noise effects on animals: A literature survey
[AD-A186922] N88-18373

ANISOTROPIC MEDIA

Time-domain reciprocity theorems for electromagnetic fields in dispersive media
[PB88-126925] N88-17886

ANISOTROPY

An analytical study of the effects of transverse shear deformation and anisotropy on natural vibration frequencies of laminated cylinders
[NASA-TM-100554] N88-17739

Bias, internal stress and substrate effects on the microstructure and properties of PVD-wear resistant coatings
[AERE-R-12360] N88-17798

The mechanism of anisotropic silicon etching and its relevance for micromachinings
[MBB-UA-1013/86] N88-17838

The physics of metallic superlattices: An experimental point of view
[DE88-003080] N88-18452

ANNEALING

Low temperature reactivity of chars towards oxygen, appendix E2
[DE88-004088] N88-17760

Experiences with serial and parallel algorithms for channel routing using simulated annealing
[NASA-CR-182530] N88-18289

High temperature processing of superconducting Y1Ba2Cu3O6.9
[DE88-003002] N88-18449

Improved magnetization for YBa2Cu3O/sub 7-delta annealed in oxygen above 1000 C
[DE88-003934] N88-18469

ANNIHILATION REACTIONS

A study of the magnetic field annihilation process in the magnetosphere and some geotechnical applications
[DE88-004165] N88-18096

Nuclear structure at intermediate energies
[TI88-002796] N88-18390

ANNUAL VARIATIONS

Effect of storage thermal behavior in seasonal storage solar heating systems
[PB88-114236] N88-18067

ANNULAR NOZZLES

Wake interaction effects on the transition process on turbine blades
[AD-A188020] N88-17962

ANNULI

The numerical and analytical study of bifurcation and multicellular flow instability due to natural convection between narrow horizontal isothermal cylindrical annuli at high Rayleigh numbers N88-17937

ANODES

Investigation of materials for inert electrodes in aluminum electrodeposition cells
[DE88-003380] N88-17906

ANODIC COATINGS

The soft/hard wet anodization of aluminum oxide and its use in a thin film multilayered capacitor
[AD-A187575] N88-17919

ANODIZING

The effect on initial bond strength and durability of a Phosphoric Acid Dip (PAD) following chromic acid anodising of aluminum
[ARE-TM(UMM)-87402] N88-17772

ANOMALIES

Persistence characteristics of 500 mb blocking and zonal flows in the mid-latitudes of the Northern and Southern Hemispheres N88-18088

ANTARCTIC REGIONS

Physical and structural characteristics of Weddell Sea pack ice
[AD-A188189] N88-18119

ANTENNA ARRAYS

Investigation of design considerations for Telemetry, Tracking and Command (TT and C) antenna system on Naval Postgraduate School Orion mini-satellite
[AD-A187130] N88-17718

ANTENNA DESIGN

Investigation of design considerations for Telemetry, Tracking and Command (TT and C) antenna system on Naval Postgraduate School Orion mini-satellite
[AD-A187130] N88-17718

User's guide for the HF (High Frequency) broadcast antenna design and validation summary programs
[PB88-116124] N88-17875

Capacitor analysis for RF antennas
[DE88-004178] N88-17883

Observation model and parameter partials for the JPL VLBI parameter estimation software MASTERFIT-1987
[NASA-CR-182524] N88-18523

ANTENNAS

The design of impedance- matching networks for broadband antennas
[AD-A187600] N88-17895

ANTIAIRCRAFT MISSILES

Dependence of the expectancy of hitting on the number of spread shots. Determination of the expectancy of hitting using a spread salvo
[REPT-FM6] N88-17829

Investigation of several spread shot conditions
[REPT-TR-164] N88-17830

POLYPHEM, a universal defensive missile with optical waveguides guidance
[MBB-UA-1045/87] N88-17862

ANTIMATTER

Antimatter: Its history and its properties
[DE88-004308] N88-18498

ANTIMISSILE DEFENSE

Signal and data processing for IR sensors N88-18199

ANTIPROTONS

Nuclear structure at intermediate energies
[TI88-002796] N88-18390

APPLICATIONS PROGRAMS (COMPUTERS)

Vibration and flutter characteristics of the SR7L large-scale propfan
[NASA-TM-100272] N88-18036

Evaluation of surface energy and radiation balance systems on the Konza Prairie
[NASA-CR-182534] N88-18097

SAGE: The Clemson University Systolic Array Generating Engine N88-18235

Parameter identification and sensitivity analysis for a robotic manipulator arm
[NASA-CR-181608] N88-18272

Benchmarks of neutral beam injection codes for stellarators
[DE88-003786] N88-18428

APPROXIMATION

Fully Lagrangian Renormalized Approximation theory of fluid turbulence
[DE88-004960] N88-17952

Explicit approximations for strictly nonlinear oscillators with slowly varying parameters with applications to free electron lasers
[DE88-004116] N88-17984

A unified framework for approximation in inverse problems for distributed parameter systems
[NASA-CR-181621] N88-18346

Eigenvalue problems
[AD-A188069] N88-18356

Advances in calculating macroionic solution structure
[DE88-003799] N88-18406

AQUEOUS SOLUTIONS

Precipitation of surfactants and surfactant mixtures in aqueous solutions
[DE88-003333] N88-17763

A review of pitting corrosion in high temperature aqueous solutions
[DE88-003547] N88-17787

ARC JET ENGINES

Arcjet thruster research and technology
[NASA-CR-180865] N88-17732

ARC WELDING

A detailed microstructural examination of the cause of HAZ cracking in type 316 steel
[AERE-R-12428] N88-17777

A generalized method for automatic downhand and wirefeed control of a welding robot and positioner
[NASA-TP-2807] N88-17869

ARCHITECTURE

Finely grained parallelism in an applicative architecture N88-18256

Introduction to a system for implementing neural net connections on SIMD architectures
[NASA-CR-181612] N88-18279

ARCHITECTURE (COMPUTERS)

Proceedings of the Workshop on Future Directions in Computer Architecture and Software
[AD-A184949] N88-18191

Some further observations about reduced instruction set computers N88-18192

An empirical analysis of the Lilith instruction set N88-18193

High-performance CPU implementation of the nebula instruction set architecture N88-18194

The arithmetic cube and its associated algorithms N88-18195

Automatically reconfigurable computer architecture N88-18204

A large-grain dataflow architecture N88-18207

A distributed system architecture based on macro dataflow model N88-18210

Future directions in computer architecture and software: The year 2000 N88-18218

An investigation of parallelism in rule based systems N88-18223

A parallel computer based on cube connected cycles N88-18227

Performance evaluation of a loop interconnection structure N88-18229

Aspects of a multiprocessor architecture N88-18232

Strategies for concurrent processing of complex algorithms N88-18236

Parallel architectures for logic programming N88-18241

Real time artificial intelligence architecture N88-18242

Future directions in computer architecture N88-18257

Future directions in computer architecture and software workshop N88-18258

A performance analysis of architectural scalability
[DE88-003537] N88-18261

Emerging supercomputer architectures
[DE88-003539] N88-18262

Supercomputer performance: The theory, practice, and results
[DE88-004697] N88-18266

Systolic array adaptive beamforming
[AD-A187496] N88-18269

MICRO system for control, acquisition and processing of experimental data
[DE88-700724] N88-18278

Using program structure to achieve prefetching for cache memories
[DE88-003599] N88-18282

CUEMAP: A tool for generating hierarchical charts and dataflow diagrams
[DE88-004778] N88-18284

Programming methodology and performance issues for advanced computer architectures
[DE88-003098] N88-18287

Implementation and analysis of a Navier-Stokes algorithm on parallel computers
[NASA-CR-181614] N88-18301

A framework for evaluating computer architectures to support systems with security requirements, with applications
[AD-A187062] N88-18303

An Ethernet local area network controller with supporting operating system software
[DE88-003534] N88-18304

Dynamic processor self-scheduling for general parallel nested loops
[DE88-003572] N88-18311

Parallel garbage collection on a virtual memory system
[DE88-003567] N88-18317

The implementation of artificial intelligence in control systems
[DE88-003497] N88-18318

Performance and evaluation at the Center for Supercomputing Research and Development
[DE88-003563] N88-18456

Center for Supercomputing Research and Development
[DE88-003564] N88-18466

ARCTIC OCEAN
Physical and structural characteristics of Weddell Sea pack ice
[AD-A188189] N88-18119

ARCTIC REGIONS
Physical and structural characteristics of Weddell Sea pack ice
[AD-A188189] N88-18119

ARGON
Rovibrational spectroscopy of ArCO van der Waals complex
[DE88-004291] N88-18387
Two-photon (VUV and visible) resonant ionization spectroscopy of atoms and molecules
[DE88-004332] N88-18388

ARID LANDS
Improved canopy reflectance modeling and scene inference through improved understanding of scene pattern
[NASA-CR-182488] N88-18049

ARITHMETIC AND LOGIC UNITS
The arithmetic cube and its associated algorithms N88-18195
The design of ultra high-speed numeric intensive systems (having fault tolerant and load balancing capabilities) N88-18196

ARMOR
Short fiber reinforced thermoplastic composites for armor applications: Interfacial bonding
[DE88-004007] N88-17742

ARRAYS
A deep-water OBS (Ocean Bottom Seismometer) array with real-time telemetry
[AD-A187404] N88-18112
Massive fine-grain parallelism in array computation: A data flow solution N88-18254

ARTEMIA
Effect of spaceflight factors on biological material flown aboard Cosmos-1514 biosatellite N88-18154

ARTERIES
Hemodynamic effects of beta-adrenergic blocking with obsidan in clinostatic and orthostatic positions N88-18171

ARTIFICIAL INTELLIGENCE
Parallel architectures for logic programming N88-18241
Real time artificial intelligence architecture N88-18242
Analysis and synthesis of adaptive neural elements
[AD-A187047] N88-18316
Parallel garbage collection on a virtual memory system
[DE88-003567] N88-18317
The implementation of artificial intelligence in control systems
[DE88-003497] N88-18318
The representation of knowledge within model-based control systems
[DE88-004863] N88-18319

ARTIFICIAL SATELLITES
Formulation methods of rigid multibody systems for large space structures and some results of computer simulation
[NAL-TR-942] N88-17730
Five-diagonal weighting scheme for geoidal profiles
[AD-A188033] N88-18054

ASBESTOS
Environmental projects. Volume 4: Asbestos survey
[NASA-CR-182527] N88-18083

ASTRONOMICAL SATELLITES
Observation model and parameter partials for the JPL VLBI parameter estimation software MASTERFIT-1987
[NASA-CR-182524] N88-18523
Deep space target location with Hubble Space Telescope (HST) and Hipparcos data
[NASA-CR-182520] N88-18524

ASTRONOMY
On the time delay of the ultrahigh-energy radiation signal from the source Cygnus X-3
[DE88-700649] N88-18547

ASTROPHYSICS
Quark matter in astrophysics and cosmology
[DE88-003406] N88-18534
Measurements of astrophysical reaction rates for radioactive samples
[DE88-004309] N88-18537

ASYMMETRY
Evaluation of magnetic coordinates in finite-beta, asymmetric plasmas
[DE88-003685] N88-18424
Asymmetric double Langmuir probe for fast and automatic measurements of plasma temperature
[DE88-004773] N88-18436

ASYMPTOTIC METHODS
On some asymptotics of laminar flow in a coiled pipe N88-17936

ASYMPTOTIC SERIES
Dynamic observers as asymptotic limits of recursive filters: Special cases
[AD-A187578] N88-18324
Asymptotic expansions for large deviation probabilities in the strong law of large numbers
[AD-A187432] N88-18361

ATLANTIC OCEAN
Meteorological and aerosol measurements from the NOAA WP-3D aircraft during WATOX-86, January 4-9, 1986
[PB88-120860] N88-18079
Trace element geochemistry of the South Atlantic Bight
[DE88-003515] N88-18108

ATMOSPHERIC CHEMISTRY
Gas phase pulse radiolysis
[DE88-002981] N88-17751
Evaluation of regional-scale air quality models: Chairmen reports from four workshops
[DE88-001397] N88-18080
The role of analytical chemistry in assessing atmospheric effects of combustion
[DE88-003909] N88-18082

ATMOSPHERIC CIRCULATION
Persistence characteristics of 500 mb blocking and zonal flows in the mid-latitudes of the Northern and Southern Hemispheres N88-18088
Application of satellite data in observational and theoretical studies of the evolving structure of baroclinic waves
[NASA-CR-179277] N88-18091

ATMOSPHERIC COMPOSITION
Tropospheric ultraviolet radiation: Assessment of existing data and effect on ozone formation
[PB88-130133] N88-18095

ATMOSPHERIC EFFECTS
User's guide for the HF (High Frequency) broadcast antenna design and validation summary programs
[PB88-116124] N88-17875
The role of analytical chemistry in assessing atmospheric effects of combustion
[DE88-003909] N88-18082

ATMOSPHERIC MODELS
Theoretical and observational problems with Holes in the far UV dayglow
[AD-A188190] N88-18100
Minimum Energy Routing through Interactive Techniques (MERIT) modeling
[NASA-CR-182535] N88-18105
A spherical, non-LTE, blanketed model stellar atmosphere for Phi Cas (FOIa) N88-18528

ATMOSPHERIC PRESSURE
The structure and dynamics of monsoon depressions N88-18102

ATMOSPHERIC RADIATION
Microscopic control of metallization stability
[AD-A187553] N88-18487

ATMOSPHERIC SOUNDING
Analysis of quasi-geostrophic forcing during the AIMCS (Airborne Investigations of Mesoscale Convective Systems) Project. Volume 2: Results for June 14 through July 16, 1984
[PB88-123807] N88-18092

ATMOSPHERIC TEMPERATURE
Statistical studies of low frequency oscillations in satellite-observed stratospheric temperatures N88-18086

ATMOSPHERIC TURBULENCE
Response of wind shear warning systems to turbulence with implication of nuisance alerts N88-17618

ATOMIC COLLISIONS
Correlated processes in atomic collisions
[DE88-003508] N88-18383

ATOMIC ENERGY LEVELS
Light absorption by an atom moving inside a spherical box
[AD-A187241] N88-18395

ATOMIC EXCITATIONS
Kinetic studies following state-selective laser excitation
[DE88-004094] N88-17981

ATOMIC PHYSICS
Application of ECR ion source beams in atomic physics
[DE88-003767] N88-18384

ATOMIC STRUCTURE
Insights into the mechanisms of chemical reactions: Reaction paths for chemical reactions
[DE88-003041] N88-17755
Investigations on the usefulness of the Massively Parallel Processor for study of electronic properties of atomic and condensed matter systems
[NASA-CR-182514] N88-18259
Energy-related atomic and molecular structure and scattering studies
[DE88-004246] N88-18388
Semiempirical studies of atomic structure
[DE88-004096] N88-18392
Electronic structure of random alloys and the theory of ordering processes
[DE88-004476] N88-18394
The electronic structure of YBa2Cu3O/sub 7-delta/ above and below T/sub c/
[DE88-003495] N88-18479

ATOMS
Light absorption by an atom moving inside a spherical box
[AD-A187241] N88-18395

ATROPHY
Investigation of rat skeletal muscles following short-term spaceflight aboard Cosmos-1667 biosatellite N88-18157

AUDIO FREQUENCIES
Complementary satellite sound broadcasting systems: A NASA assessment for the Voice of America
[NASA-TM-100300] N88-17899

AUGER SPECTROSCOPY
Metal modification for improved glass-ceramic to metal seals: 1. Auger results on ion implantation and vapor deposition films
[DE88-005244] N88-18006

AUSTENITE
Response of Fe-Cr-Mn austenitic alloys to thermal aging neutron irradiation
[DE88-003415] N88-17785

AUSTENITIC STAINLESS STEELS
The role of composition and microstructure gradients on weld metal properties and behavior
[DE88-004956] N88-17791

AUTOCORRELATION
Autocorrelation of control points on 11-band multispectral imagery
[AD-A188185] N88-18056

AUTOIONIZATION
Theoretical studies of atomic transitions
[DE88-004719] N88-18389

AUTOMATIC CONTROL
A smart, mapping, charting and geodesy control generator, phase 1
[AD-A188184] N88-18055
A collaborative program of research in engineering sciences
[DE88-003383] N88-18504

AUTONOMOUS NAVIGATION
An overview of vision-based navigation for autonomous land vehicles 1986
[AD-A188186] N88-17640

AUTORADIOGRAPHY
High resolution electron and ion microscopy
[AERE-R-12502] N88-17754
Optimization of the southern electrophoretic transfer method
[DE88-004527] N88-17765

AUTOREGRESSIVE PROCESSES
Identifiability of multivariate ARMA models
[AD-A187394] N88-18350

AUXILIARY POWER SOURCES
Design and testing of a small radial turbine for auxiliary power units N88-17661

AUXILIARY PROPULSION
Component data base for space station resistojet auxiliary propulsion
[NASA-CR-180834] N88-17731

AVAILABILITY
Resilient procedures: A structured replication approach N88-18245

AVIATION METEOROLOGY
AEV local verification for aviation, precipitation and temperature programs: AV, REL, TEM (September 1987 revision)
[PB88-115662] N88-18101

AVIONICS
Helicopter activities in Germany
[MBB-UD-487/86] N88-17853
Navigation recovery block design description
[NASA-CR-182473] N88-18022

AVOIDANCE
Windshear training aid. Volume 1: Overview, pilot guide, training program
[PB88-127196] N88-17837

AXES OF ROTATION
Study on a rotor speed control system for a horizontal axis windmill
[NAL-TR-931] N88-18062

AXIAL FLOW
Computation of secondary flows in an axial multistage compressor N88-17681
AXIAL FLOW TURBINES
Modal testing of a very flexible 110 m wind turbine structure
[DE88-003796] N88-18072
AXISYMMETRIC FLOW
Numerical simulation of axisymmetric turbulent flow in combustors and diffusors
[NASA-CR-4115] N88-17582
On the interaction of Tollmein-Schlichting waves in axisymmetric supersonic flows
[NASA-CR-181619] N88-17955
AZULENE
Energy transfer studies with lasers
[DE88-004864] N88-17991
AZUR SATELLITE
AZUR, the first German research satellite 625-A, 1964-1969 N88-17827

B

B STARS
A spherical, non-LTE, blanketed model stellar atmosphere for Phi Cas (FOIa) N88-18528
BACKGROUND NOISE
The assessment of the sound insulation requirements for a large broadcasting studio, using a scale model: Practical details
[BBC-RD-1987/21] N88-17878
BACKGROUND RADIATION
The origin of the diffuse X-ray background and the formation of galaxies and voids N88-18527
BACTERIA
Analysis of gases in the earth's crust
[PB88-141619] N88-18093
BALLISTIC MISSILES
Rocket and airjet propulsion for ballistic and aerodynamic space probes
[REPT-TR-527] N88-17826
Where directed energy stands in strategic defense
[DE88-005092] N88-18365
BALLISTIC TRAJECTORIES
Ballistic Single Stage Carrier Vehicle (BETA): A single stage reusable ballistic space shuttle concept
[MBB-UR-949/70] N88-17828
BAND STRUCTURE OF SOLIDS
The band systems of alkali vapors
[NASA-TT-20206] N88-18462
BARIUM OXIDES
The structure and properties of twin boundaries in superconducting YBa2Cu3O7
[DE88-003864] N88-18466
Improved magnetization for YBa2Cu3O/sub 7-delta annealed in oxygen above 1000 C
[DE88-003934] N88-18469
Freestanding films of YBa2Cu3O/sub 6.9/
[DE88-003995] N88-18471
Grain boundaries, planar defects and superconducting properties of YBa2Cu3O7
[DE88-003477] N88-18475
Superconductivity and phase stability in the heavy rare earth quaternary compounds RBa2Cu3O7 (R = Ho, Er, Tm, Yb, Lu)
[DE88-003478] N88-18476
Superconducting properties and structural characterization of high T/sub c/ oxides
[DE88-003479] N88-18477
Penetration depth measurements of YBa2Cu3O/sub 7-delta/ at 4 MHz
[DE88-003493] N88-18478
The electronic structure of YBa2Cu3O/sub 7-delta/ above and below T/sub c/
[DE88-003495] N88-18479
Simulation and processing of high resolution images of defects and interfaces in superconducting YBa2Cu3O7
[DE88-003856] N88-18480
High-resolution X-ray microstructural study of single crystals of YBa2Cu3O/sub 7-y/
[DE88-004856] N88-18484
BAROCLINIC WAVES
Application of satellite data in observational and theoretical studies of the evolving structure of baroclinic waves
[NASA-CR-179277] N88-18091
BAROTROPISM
On the barotropic model of the ocean circulation
[AD-A186148] N88-18118
BARRIER LAYERS
Ytterbium monolayer diffusion barriers at Hg(1-x)Cd(x)Te/Al junctions
[AD-A188013] N88-17768
BATHING
Analysis of water recovered after being used for washing by men and women N88-18135
BEAM INJECTION
Preliminary injector, accelerator, and beamline design for rf-linac-driven XUV free-electron lasers
[DE88-003185] N88-17983
The numerical simulation of accelerator components
[DE87-011597] N88-18423
Benchmarks of neutral beam injection codes for stellarators
[DE88-003786] N88-18428
Effects of X irradiation and high field electron injection on the electrical properties of rapid thermal oxides
[DE88-002642] N88-18461
BEAMS (RADIATION)
A ring model of the lasertron
[DE88-004856] N88-17908
BEAMS (SUPPORTS)
Composite materials for rail transit systems
[NASA-CR-178401] N88-17738
Strategic placement of accelerometers to measure forces by the sum of weighted accelerations
[DE88-002262] N88-17968
Robust controller design for flexible structures
[AD-A187217] N88-18009
Some aspects of the mechanics and mechanisms of dynamic brittle fracture N88-18028
Piezoelectric laminates for torsional and bending model control: Theory and experiment N88-18029
BEARINGLESS ROTORS
Special flight mechanical features of the bearingless helicopter rotor
[MBB-FM-315/O] N88-17825
Testing of a tail rotor system in a fiber composite type of construction
[MBB-UD-472/86] N88-17854
Comprehensive analysis of helicopters with bearingless rotors
[NASA-CR-182537] N88-18300
BEARINGS
Optimal design and parameter identification of flexible rotor-bearing systems N88-18002
BEHAVIOR
Innovation and creativity: A critical linkage
[DE88-003309] N88-18515
BENDING
Piezoelectric laminates for torsional and bending model control: Theory and experiment N88-18029
Benchmark computation and finite element performance evaluation for a rhombic plate bending problem
[AD-A187402] N88-18041
BETATRONS
Betatron oscillations in a free electron laser
[DE88-004859] N88-17990
BIAS
On precision and accuracy (bias) statements for measurement procedures
[DE88-004434] N88-18359
BIBLIOGRAPHIES
Earth resources: A continuing bibliography with indexes (supplement 56)
[NASA-SP-7041(56)] N88-18051
Aerospace medicine and biology: A cumulative index to a continuing bibliography (supplement 306)
[NASA-SP-7011(306)] N88-18180
Aerospace medicine and biology: A continuing bibliography with indexes (supplement 308)
[NASA-SP-7011(308)] N88-18183
Recent progress in the dynamic applications of piezoelectric crystals N88-18460
NASA patent abstracts bibliography: A continuing bibliography. Section 2: Indexes (supplement 32)
[NASA-SP-7039(32)-SECT-2] N88-18511
BINARY STARS
The formation of single millisecond pulsars in globular clusters
[MPE-PREPRINT-97] N88-18525
BINDERS (MATERIALS)
Thermoplastic elastomers as LOVA binders
[AD-A186563] N88-17797
NMR (Nuclear Magnetic Resonance) imaging for detecting binder/plasticizers in green-state structural ceramics
[DE88-003111] N88-17800
BINDING
Tight binding theory of semiconductors N88-18447
BIOCHEMISTRY
Project Explorer takes its second step: GAS-608 in engineering development N88-17707
Human blood glutamic acid level with exposure to high ambient concentrations of ammonia N88-18134
New book on metabolic aspects of spaceflight stress N88-18172
BIOGRAPHY
Messerschmitt-Boelkow-Blohm: Biography and history of a company N88-17867
BIOLOGICAL EFFECTS
Kinetic toxic aspect of potential use of sulfur hexafluoride in closed environments N88-18142
Effect of external electrostatic field on catecholamine secretion by rat adrenals N88-18166
Aerospace medicine and biology: A cumulative index to a continuing bibliography (supplement 306)
[NASA-SP-7011(306)] N88-18180
Aerospace medicine and biology: A continuing bibliography with indexes (supplement 308)
[NASA-SP-7011(308)] N88-18183
BIOPHYSICS
Evaluation of spare room in cerebrospinal system using noninvasive methods N88-18137
Two-dimensional static otolith model N88-18167
BIPOLAR TRANSISTORS
On the choice of a element low-noise preamplifier on bipolar transistors
[DE88-700839] N88-17904
BIT ERROR RATE
Implementation of encoders and decoders for Reed-Solomon codes
[PB88-126628] N88-18286
BITUMENS
Evaluation of bituminous materials used in pavement recycling projects at Tyndall, MacDill, and Hurlburt Air Force Bases
[AD-A188068] N88-17871
BLADES
Vibration and flutter characteristics of the SR7L large-scale propfan
[NASA-TM-100272] N88-18036
BLANKETS (FUSION REACTORS)
Physics modeling support contract
[DE88-004039] N88-17980
BLOCKING
Persistence characteristics of 500 mb blocking and zonal flows in the mid-latitudes of the Northern and Southern Hemispheres N88-18068
BLOOD CIRCULATION
Effect of spaceflight factors on primate's blood circulation N88-18124
Isotope methods of determining distribution and movement of blood in the body N88-18138
Comparative evaluation of orthostatic stability following immersion in horizontal and vertical positions N88-18143
Effect of antiorthostatic position and different illumination on sensitivity of skin in upper half of the body to ultraviolet radiation N88-18145
Improvement of human tolerance to head-pelvis (+Gz) accelerations by increasing hydration N88-18153
Effect of exogenous cardiosynchronized counterpulsation on human regional and central hemodynamics N88-18163
BLOOD COAGULATION
Role of carbon dioxide in correction of coagulation hemostasis under hypoxic conditions N88-18160
BLOWING
An aerodynamic comparison of blown and mechanical high lift airfoils N88-17606
BLUNT BODIES
Hypersonic blunt body computations including real gas effects
[NASA-TM-100074] N88-18344
BODY FLUIDS
Effect of spaceflight factors on primate hydration homeostasis N88-18126
The precision of limits on bodily fluids when using beta-expectation inner tolerance limits
[AD-A187966] N88-18185
BODY-WING AND TAIL CONFIGURATIONS
Investigation of the influence of wind shear on the aerodynamic characteristics of aircraft using a vortex-lattice method N88-17619
BONDING
Tight binding theory of semiconductors N88-18447
BONE DEMINERALIZATION
Histomorphometric analysis of rat bones after spaceflight aboard Cosmos-1667 biosatellite N88-18128
NASA Workshop on Biological Adaptation
[NASA-TM-89468] N88-18174
BONES
Histomorphometric analysis of rat bones after spaceflight aboard Cosmos-1667 biosatellite N88-18128
Morphological study of early changes in rat bones in simulated weightlessness N88-18158
BORN APPROXIMATION
Inversion of parabolic and paraboloidal projections
[AD-A187538] N88-18380

BORON FIBERS
Analytical and experimental characterization of damage processes in composite laminates
[AD-A187221] N88-17746
BOUNDARIES
Boundary stabilization of thin elastic plates
[AD-A187123] N88-18025
Numerical studies of propagation of Lg waves across ocean continent boundaries using the Representation Theorem (RT) N88-18085
Probability bounds for M-Skorohod oscillations
[AD-A187981] N88-18371
BOUNDARY INTEGRAL METHOD
Boundary integral analysis of flow and deformation of long bubbles in capillaries
[DE88-002110] N88-17927
Boundary-integral-equation method for computing the three-dimensional flow of groundwater
[PB88-126891] N88-17951
Fast Poisson solver on irregular regions by boundary integral-based domain decomposition methods
[DE88-003583] N88-18340
BOUNDARY LAYER CONTROL
Control of vortical separation on conical bodies N88-17580
Reduction of tilt rotor download using circulation control N88-17605
BOUNDARY LAYER FLOW
A theory for turbulent curved wall jets N88-17590
The further development of circulation control airfoils N88-17594
Boundary-layer and wake measurements on a swept, circulation-control wing N88-17597
Boundary integral analysis of flow and deformation of long bubbles in capillaries
[DE88-002110] N88-17927
BOUNDARY LAYER SEPARATION
Burst vortex/boundary layer interaction
[NASA-CR-182510] N88-17583
A theory for turbulent curved wall jets N88-17590
Pressure distributions and oil-flow patterns for a swept circulation-control wing N88-17596
Experimental research on swept shock wave/boundary layer interactions
[AD-A187250] N88-17957
BOUNDARY LAYER TRANSITION
Wake interaction effects on the transition process on turbine blades
[AD-A186020] N88-17962
BOUNDARY LAYERS
Free-surface flow phenomena ahead of a two-dimensional body in a viscous fluid N88-17944
Experimental research on swept shock wave/boundary layer interactions
[AD-A187250] N88-17957
BOUNDARY VALUE PROBLEMS
An experimental investigation of pressure driven three-dimensional turbulent boundary layers N88-17934
Free-surface flow phenomena ahead of a two-dimensional body in a viscous fluid N88-17944
The h-p version of the finite element method for problems with nonhomogeneous essential boundary condition
[AD-A187356] N88-18348
Boundary value problems for differential and functional differential equations
[AD-A187378] N88-18349
On an overdetermined Neumann problem
[AD-A187451] N88-18352
Time delays and boundary feedback stabilization in one-dimensional viscoelasticity, appendices A through H
[AD-A187534] N88-18353
BRAIN
Effect of exogenous cardiosynchronized counterpulsation on human regional and central hemodynamics N88-18163
BRANCHING (MATHEMATICS)
Local bifurcation control
[AD-A187435] N88-17915
BRANCHING (PHYSICS)
The numerical and analytical study of bifurcation and multicellular flow instability due to natural convection between narrow horizontal isothermal cylindrical annuli at high Rayleigh numbers N88-17937
BRAZING
Transmission electron microscopy studies of titanium-containing braze/alumina seals
[DE88-005243] N88-17792
BRIGHTNESS
Bright source lasers and experiments at very high irradiance
[DE88-004317] N88-17988
Relaxing the brightness constancy assumption in computing optical flow
[AD-A187437] N88-18410
BRIGHTNESS TEMPERATURE
Statistical studies of low frequency oscillations in satellite-observed stratospheric temperatures N88-18086
BRILLOUIN ZONES
Positron-annihilation 2D-ACAR studies of disordered and defected alloys
[DE88-003118] N88-18454
BRITTLENESS
Some aspects of the mechanics and mechanisms of dynamic brittle fracture N88-18028
Brittle to ductile transition to cleavage fracture
[DE88-004074] N88-18481
BROADBAND
Signal processing for an optical wide band data transmission system
[DE88-003854] N88-17888
Wide band data transmission system using optical fibers
[DE88-004555] N88-17889
The design of impedance- matching networks for broadband antennas
[AD-A187600] N88-17895
Low-noise cryogenically cooled broad-band microwave preamplifiers
[DE88-004561] N88-17912
Nonlinear optics with broad-band lasers
[DE88-005026] N88-17992
BROADCASTING
User's guide for the HF (High Frequency) broadcast antenna design and validation summary programs
[PB88-116124] N88-17875
The assessment of the sound insulation requirements for a large broadcasting studio, using a scale model: Practical details
[BBC-RD-1987/21] N88-17878
Complementary satellite sound broadcasting systems: A NASA assessment for the Voice of America
[NASA-TM-100300] N88-17899
Role of broadcasting in multiprocessor systems N88-18201
BUBBLES
Boundary integral analysis of flow and deformation of long bubbles in capillaries
[DE88-002110] N88-17927
Mechanistic model for void distribution in flashing flow
[DE88-002948] N88-17928
BUILDINGS
Experimental studies of heat and mass exchange in parallel-passage rotary desiccant dehumidifiers for solar cooling applications
[DE88-001119] N88-18069
BUOYANCY
A payload for investigating the influence of convection on GaAs crystal growth N88-17702
Application of a multigrid method to a buoyancy-induced flow problem
[DE88-003961] N88-18326
BUOYS
A deep-water OBS (Ocean Bottom Seismometer) array with real-time telemetry
[AD-A187404] N88-18112
BURNERS
Development of a plenum chamber burner system for an advanced VTOL engine N88-17664

C

CADMIUM TELLURIDES
CdTe(110)-Mn interface reaction and the formation of non-equilibrium ternary semimagnetic semiconductor alloys
[AD-A187593] N88-18491
CALCULUS OF VARIATIONS
Studies in finite time thermodynamics
[DE88-004531] N88-18500
CALIBRATING
Signal processing studies program optical signal amplification, volume 2
[AD-A188054] N88-17896
Johnson noise thermometer for high radiation and high temperature environments
[DE88-003770] N88-17911
A technique for low level, wide range CW microwave power meter calibrations
[DE88-004147] N88-17966
NBS (National Bureau of Standards) measurement services: Spectral irradiance calibrations
[PB88-123781] N88-18401
CALIFORNIA
CTD observations in the coastal transition zone off northern California, 16-25 February 1987
[AD-A187283] N88-18111
Numerical simulations of the California current: Filament formation as related to baroclinic instability
[AD-A187573] N88-18115
CANOPIES (VEGETATION)
Improved canopy reflectance modeling and scene inference through improved understanding of scene pattern
[NASA-CR-182488] N88-18049
CANTILEVER BEAMS
A fiber-resin micromechanics analysis of the delamination front in a DCB specimen
[NASA-TM-100540] N88-17737
CAPACITANCE
Design of a charge sensitive preamplifier on high resistivity silicon
[DE88-003491] N88-17907
Capacitive charge division in centroid finding cathode readouts in MWPCs
[DE88-003545] N88-17969
CAPACITORS
Capacitor analysis for RF antennas
[DE88-004178] N88-17883
Pulsed current transformer for low inductive loads
[AD-A187224] N88-17913
The soft/hard wet anodization of aluminum oxide and its use in a thin film multilayered capacitor
[AD-A187575] N88-17919
CAPILLARY FLOW
Study of helium transfer technology for STICCR: Fluid management
[NASA-CR-177463] N88-17720
CAPILLARY TUBES
Boundary integral analysis of flow and deformation of long bubbles in capillaries
[DE88-002110] N88-17927
CARBIDES
Effects of ion implantation on cavitation erosion of a cobalt based metal/carbide alloy
[AD-A187239] N88-17793
CARBON DIOXIDE
Energy transfer studies with lasers
[DE88-004864] N88-17991
Role of carbon dioxide in correction of coagulation hemostasis under hypoxic conditions N88-18160
CARBON DIOXIDE LASERS
Airborne Doppler lidar detection of wind shear. Results of performance analysis N88-17627
Experiments for the high resolution detection of moving targets using a CO2 laser radar
[MBB-UA-1044/87] N88-17864
CARBON FIBERS
Effect of post-cure heat-treatment on static and fatigue behaviour of XAS-914C carbon fibre composite
[AD-A186943] N88-17735
Effects of aviation fluids on carbon fibre composite material
[PB88-127857] N88-17740
Effect of thermal shock on carbon fiber/epoxy composites
[PB88-128228] N88-17741
CARBON MONOXIDE
Energy transfer studies with lasers
[DE88-004864] N88-17991
Investigation of effects of short-term exposure to high concentrations of carbon monoxide on operator's psychophysiological functions N88-18133
CARBONATES
Determination of optimum electrolyte composition for molten carbonate fuel cells literature review
[DE88-001015] N88-18058
CARBURIZING
Effects of ion implantation on cavitation erosion of a cobalt based metal/carbide alloy
[AD-A187239] N88-17793
CARDIOVASCULAR SYSTEM
Forecasting complications of cardiovascular disease in flight personnel N88-18136
JPRS Report: Science and Technology. USSR: Space Biology and Aerospace Medicine, volume 21, no. 6, November - December 1987
[JPRS-USB-88-004] N88-18150
Results of long-term electrocardiographic monitoring of cosmonauts N88-18152
Effect of hypercapnic-hypoxic test on carioreспiratory parameters of individuals with neurocirculatory dystonia N88-18169
CARDS
The effects of data structure on total time on test plots
[AD-A187628] N88-18296
Optical memory cards: A comparison with other current technologies and potential military applications
[AD-A187287] N88-18512

CARGO SPACECRAFT
STS propellant scavenging systems study. Part 2, volume 2: Cost and WBS/dictionary
[NASA-CR-179276] N88-17717
CARRIER TO NOISE RATIOS
The relationship between vision carrier-to-noise ratio and picture signal-to-noise ratio in a System I television receiver
[BBC-RD-1987/23] N88-17677
CASCADE FLOW
The unsteady gas flow through stator and rotor of a turbomachine N88-17660
Transonic blade design on rotational stream surfaces N88-17671
Investigation of dihedral effects in compressor cascades N88-17672
Flow patterns induced by vortices
[NAL-TR-932] N88-17963
CAST ALLOYS
Durability and damage tolerance of aluminum castings
[AD-A186444] N88-18013
CASTING
Materials development for JPL oxygen plant
[DE88-003067] N88-17752
CATALOGS
Component data base for space station resistojet auxiliary propulsion
[NASA-CR-180834] N88-17731
CATHODES
Investigation of materials for inert electrodes in aluminum electrodeposition cells
[DE88-003380] N88-17906
Capacitive charge division in centroid finding cathode readouts in MWPCs
[DE88-003545] N88-17969
CATIONS
Precipitation of surfactants and surfactant mixtures in aqueous solutions
[DE88-003333] N88-17763
CAUCHY PROBLEM
Detection of signals in non-Gaussian correlated noise derived from Cauchy processes
[AD-A187488] N88-17894
CAVITATION CORROSION
Effects of ion implantation on cavitation erosion of a cobalt based metal/carbide alloy
[AD-A187239] N88-17793
CAVITATION FLOW
Effects of ion implantation on cavitation erosion of a cobalt based metal/carbide alloy
[AD-A187239] N88-17793
The use of multigrid techniques in the solution of the Elrod algorithm for a dynamically loaded journal bearing
[NASA-CR-180873] N88-17954
CAVITIES
Evaluation of spare room in cerebrospinal system using noninvasive methods N88-18137
CDC CYBER 205 COMPUTER
An efficient sparse matrix multiplication scheme for the CYBER 205 computer
[NASA-TM-4028] N88-18302
CELLS (BIOLOGY)
Histomorphometric analysis of rat bones after spaceflight aboard Cosmos-1667 biosatellite N88-18128
Effect of weightlessness on replicative function of rat hepatocyte DNA N88-18129
Morphological and functional state of the hypothalamo-hypophyseal neurosecretory system of rats flown aboard Cosmos-1667 N88-18156
Interactions of cultured human endothelial cells with polymeric surfaces
[PB88-112255] N88-18178
CENSORED DATA (MATHEMATICS)
A generalized quantile estimator under censoring
[AD-A188280] N88-18364
CENTRAL AMERICA
Geological evolution and analysis of confirmed or suspected gas hydrate localities. Volume 9: Formation and stability of gas hydrates of the Middle America Trench
[DE88-001007] N88-18050
CENTRAL NERVOUS SYSTEM
Discrete adaptation to sensory conflict N88-18146
Combined effect of ionizing radiation and altered gas atmosphere on central nervous system N88-18168
CENTRAL PROCESSING UNITS
High-performance CPU implementation of the nebula instruction set architecture N88-18194
Implementation of a buddy failure recovery concept in the NOVAC system N88-18205
CENTRIFUGAL COMPRESSORS
The advantage of variable geometry for turbine engines at low power N88-17653
Secondary flow measurements with L2F-technique in centrifugal compressors N88-17676
Method for predicting performance limits of centrifugal compressors N88-17677
CENTRIFUGAL FORCE
Two-dimensional static otolith model N88-18167
CERAMIC FIBERS
High-temperature properties of ceramic fibers and insulations for thermal protection of atmospheric entry and hypersonic cruise vehicles
[NASA-TM-100059] N88-17743
CERAMICS
Fabrication and materials evaluation of high performance aligned ceramic fibre reinforced glass matrix composite
[AERE-R-12517] N88-17736
Materials development for JPL oxygen plant
[DE88-003067] N88-17752
Friction and wear of monolithic and fiber reinforced silicon-ceramics sliding against IN-718 alloy at 25 to 800 C in atmospheric air at ambient pressure
[NASA-TM-100294] N88-17796
NMR (Nuclear Magnetic Resonance) imaging for detecting binder/plasticizers in green-state structural ceramics
[DE88-003111] N88-17800
Adhesion, friction and micromechanical properties of ceramics
[NASA-TM-100782] N88-17801
Tribology of ceramics: Report of the Committee on Tribology of Ceramics
[NASA-CR-182506] N88-17802
Effect of translucence of engineering ceramics on heat transfer in diesel engines
[DE88-003732] N88-17804
Fabrication, phase transformation studies and characterization of SiC-AlN-Al2OC ceramics
[DE88-004053] N88-17807
The migration of grain boundaries in ceramic materials with particular reference to the sintering process
[DE88-004085] N88-17808
Metal modification for improved glass-ceramic to metal seals: 1. Auger results on ion implantation and vapor deposition films
[DE88-005244] N88-18006
Ceramic bearings for use in gas turbine engines
[NASA-TM-100288] N88-18007
CEREBROSPINAL FLUID
Evaluation of spare room in cerebrospinal system using noninvasive methods N88-18137
CERTIFICATION
Airworthiness considerations N88-17636
CHANNEL FLOW
Instability and transition in curved channel flow N88-17938
CHANNELS (DATA TRANSMISSION)
Multiple-bus interconnection for future multiprocessor systems N88-18203
Experiences with serial and parallel algorithms for channel routing using simulated annealing
[NASA-CR-182530] N88-18289
CHAOS
Instabilities and chaos in a multimode, standing-wave, CW dye laser
[DE88-005028] N88-17993
CHARGE CARRIERS
Electronic structure, charge transfer excitations and high temperature superconductivity
[DE88-003096] N88-18453
CHARGE COUPLED DEVICES
New generation imager system
[NASA-CR-180464] N88-18398
CHARGE DISTRIBUTION
Capacitive charge division in centroid finding cathode readouts in MWPCs
[DE88-003545] N88-17969
Application of ECR ion source beams in atomic physics
[DE88-003767] N88-18384
CHARGE TRANSFER
Electronic structure, charge transfer excitations and high temperature superconductivity
[DE88-003096] N88-18453
CHARGED PARTICLES
Performance and optimization of direct implicit time integration schemes for use in electrostatic particle simulation codes
[DE88-003254] N88-18381
Forces on neutral atoms due to electromagnetic fields
[AD-A187461] N88-18396
CHARRING
Low temperature reactivity of chars towards oxygen, appendix E2
[DE88-004088] N88-17760
CHECKOUT
Debugging FORTRAN on a shared memory machine
[DE88-003589] N88-18276
CHEMICAL ANALYSIS
Ion chromatography in the manufacture of multilayer circuit boards
[DE88-002428] N88-17902
The role of analytical chemistry in assessing atmospheric effects of combustion
[DE88-003909] N88-18082
Analysis of gases in the earth's crust
[PB88-141619] N88-18093
Analysis of water recovered after being used for washing by men and women N88-18135
CHEMICAL BONDS
Basic research on macromolecular dynamics
[PB88-141643] N88-17805
Rovibrational spectroscopy of ArCO van der Waals complex
[DE88-004291] N88-18387
Chemical activation of molecules by metals: Experimental studies of electron distributions and bonding
[DE88-004465] N88-18393
CHEMICAL COMPOSITION
Application of inverse gas chromatography to fluidity studies
[DE88-002896] N88-17750
The measurement of chemical compositon with high spatial resolution using a dedicated scanning transmission electron microscope
[AERE-R-12317] N88-17753
Electrically conducting polymer-copper sulphide composite films, preparation by treatment of polymer-copper (2) acetate composites with hydrogen sulfide
[NASA-TT-20204] N88-17803
Acoustic emission-microstructural relations in ferritic steels. Part 3: The effect of inclusion content
[AERE-R-12041] N88-18015
Determination of optimum electrolyte composition for molten carbonate fuel cells literature review
[DE88-001015] N88-18058
Normal and superconducting state properties of La2-xSr/sub x/CuO4
[DE88-003013] N88-18450
CHEMICAL LASERS
A chemical precursor to optical damage. Studies by laser ionization mass spectrometry
[DE88-004321] N88-18408
CHEMICAL PROPERTIES
Chemical activation of molecules by metals: Experimental studies of electron distributions and bonding
[DE88-004465] N88-18393
Utilization of the JANAF (Joint Army Navy Air Force) database for chemical thermodynamic calculations
[DE88-004571] N88-18501
CHEMICAL REACTIONS
Gas phase pulse radiolysis
[DE88-002981] N88-17751
Insights into the mechanisms of chemical reactions: Reaction paths for chemical reactions
[DE88-003041] N88-17755
Precipitation of surfactants and surfactant mixtures in aqueous solutions
[DE88-003333] N88-17763
The chemistry of the hypochlorite neutralization of hydrazine fuels
[DE88-002971] N88-17812
Laser studies of the dynamics of free radical reactions
[DE88-004431] N88-17989
Chemical activation of molecules by metals: Experimental studies of electron distributions and bonding
[DE88-004465] N88-18393
CHEMICAL REACTORS
Mechanistic model for void distribution in flashing flow
[DE88-002948] N88-17928
CHEMISORPTION
Low temperature reactivity of chars towards oxygen, appendix E2
[DE88-004088] N88-17760
CHINA
An evaluation of effectiveness of PTFE (polytetrafluoroethylene) type friction reducers on reducing friction and wear
[AD-A187440] N88-18010
CHIPS (ELECTRONICS)
On systolic architectures for interpolation and integration N88-18250
CHIRAL DYNAMICS
The hybrid Monte Carlo Algorithm and the chiral transition
[DE88-004305] N88-18341
Comment on the Adler-Bardeen theorem and related problems
[DE88-751051] N88-18367

CHLORIDES
Corrosion behavior of sputter-deposited aluminum-based alloys exposed to chloride solutions
[AD-A187262] N88-17794
CHOKES
Parametric study of choke flutter with a linear theory
N88-17673
CHROMATOGRAPHY
Ion chromatography in the manufacture of multilayer circuit boards
[DE88-002428] N88-17902
CHROMIC ACID
The effect on initial bond strength and durability of a Phosphoric Acid Dip (PAD) following chromic acid anodising of aluminum
[ARE-TM(UMM)-87402] N88-17772
CHROMIUM ALLOYS
Response of Fe-Cr-Mn austenitic alloys to thermal aging neutron irradiation
[DE88-003415] N88-17785
The role of composition and microstructure gradients on weld metal properties and behavior
[DE88-004956] N88-17791
CHRONOLOGY
Data-base of Antarctic pre-Pleistocene sediment cores
[PB88-124151] N88-18094
CIRCADIAN RHYTHMS
Inflight simian circadian rhythms and temperature homeostasis aboard Cosmos-1514 biosatellite
N88-18125
CIRCUIT BOARDS
Ion chromatography in the manufacture of multilayer circuit boards
[DE88-002428] N88-17902
CIRCUIT RELIABILITY
An integrated pressure sensor for in-vivo use
N88-17965
CIRCUITS
Signal processing for an optical wide band data transmission system
[DE88-003854] N88-17888
CIRCULAR CYLINDERS
A large strain thermomechanical forming model for elastic-viscoplastic behavior in metals N88-17780
Time-resolved heat transfer measurements and analysis in the wage region of a cylinder in crossflow
N88-17939
CIRCULATION CONTROL AIRFOILS
Proceedings of the Circulation-Control Workshop, 1986
[NASA-CP-2432] N88-17586
Navier-Stokes calculations and turbulence modeling in the trailing edge region of a circulation control airfoil
N88-17587
Wall jet analysis for circulation control aerodynamics. Part 1: Fundamental CFD and turbulence modeling concepts N88-17588
Investigations of a circulation control airfoil flowfield using an advanced laser velocimeter N88-17589
Evaluation of a research circulation control airfoil using Navier-Stokes methods N88-17591
Navier-Stokes computations for circulation control airfoils N88-17592
Wall jet analysis for circulation control aerodynamics. Part 2: Zonal modeling concepts for wall jet/potential flow coupling N88-17593
The further development of circulation control airfoils
N88-17594
On the effect of leading edge blowing on circulation control airfoil aerodynamics N88-17595
Pressure distributions and oil-flow patterns for a swept circulation-control wing N88-17596
Boundary-layer and wake measurements on a swept, circulation-control wing N88-17597
Wind tunnel studies of circulation control elliptical airfoils N88-17598
An aerodynamic comparison of blown and mechanical high lift airfoils N88-17606
Fixed wing CCW aerodynamics with and without supplementary thrust deflection N88-17607
Development of circulation control technology for powered-lift STOL aircraft N88-17608
A potential flight evaluation of an upper-surface-blowing/circulation-control-wing concept
N88-17609
Circulation control STOL aircraft design aspects
N88-17610
CIRCULATION CONTROL ROTORS
Proceedings of the Circulation-Control Workshop, 1986
[NASA-CP-2432] N88-17586
Flap-lag-torsion aeroelastic stability of a circulation control rotor in forward flight N88-17600
The impact of circulation control on rotary aircraft controls systems N88-17601
Analysis of a fixed-pitch X-wing rotor employing lower surface blowing N88-17602
Prediction of aeroelastic response of a model X-wing rotor N88-17603
X-wing potential for Navy applications N88-17604
Reduction of tilt rotor download using circulation control N88-17605
CIRCULATORY SYSTEM
Oxidative enzyme activity in healthy subjects and individuals with neurocirculatory dystonia during graded exercise N88-18170
CIVIL AVIATION
Product planning in civil aircraft construction
[MBB-UT-002/87] N88-17849
Minimum Energy Routing through Interactive Techniques (MERIT) modeling
[NASA-CR-182535] N88-18105
CLADDING
Beneficial and detrimental effects of silica in the high temperature oxidation of 20Cr/25Ni/Nb stainless steel
[AERE-R-12667] N88-17779
Effects of commercial cladding on the fracture behavior of pressure vessel steel plates
[DE88-004333] N88-17790
CLASSIFICATIONS
Rapid underway sediment classification by electrical methods
[AD-A187447] N88-18113
Rapid underway sediment classification by electrical methods
[AD-A187477] N88-18114
CLEAR AIR TURBULENCE
Infrared low-level wind shear work N88-17628
CLEAVAGE
Brittle to ductile transition to cleavage fracture
[DE88-004074] N88-18481
CLIMATE
Parameterization of radiative transfer in the Earth's atmosphere with specific applications to clouds
N88-18087
CLIMATOLOGY
US Navy climatic study of the Mediterranean Sea
[AD-A188264] N88-18107
CLINICAL MEDICINE
Relationships between coronary heart disease risk factors and serum ionized calcium in Kennedy Space Center Cohort
[NASA-TM-100979] N88-18177
Basic results of medical studies during prolonged manned flights on-board the Salyut-7/Soyuz-T orbital complex
[NASA-TT-20217] N88-18182
Minutes of the meeting of the Indo-US Subcommission on Science and Technology (8th) held at Washington, D.C. on September 22-24, 1986
[PB88-130158] N88-18503
CLOSED ECOLOGICAL SYSTEMS
Kinetic toxic aspect of potential use of sulfur hexafluoride in closed environments N88-18142
CLOUD COVER
Application of satellite data in observational and theoretical studies of the evolving structure of baroclinic waves
[NASA-CR-179277] N88-18091
CLOUDS (METEOROLOGY)
Parameterization of radiative transfer in the Earth's atmosphere with specific applications to clouds
N88-18087
CLUTTER
Radar backscatter from airports and surrounding areas N88-17623
Radar returns from ground clutter in vicinity of airports
N88-17624
CMOS
Effect of the gate oxide thickness on the speed of MOS integrated circuits
[PB88-155783] N88-17910
Latent failures and coverage in fault-tolerant systems. A VLSI CMOS circuit design technique to aid test generation
[AD-A187615] N88-17921
COAL
Application of inverse gas chromatography to fluidity studies
[DE88-002696] N88-17750
High-density jet fuels from coal syncrudes, appendix 4
[DE88-003132] N88-17813
The role of repowering in America's power generation future
[DOE/FE-0096] N88-18076
COAL GASIFICATION
Low temperature reactivity of chars towards oxygen, appendix E2
[DE88-004088] N88-17760
COAL LIQUEFACTION
High-density jet fuels from coal syncrudes, appendix 4
[DE88-003132] N88-17813
COALESCING
Loop coalescing: A compiler transformation for parallel machines
[DE88-003571] N88-18307
COANDA EFFECT
Proceedings of the Circulation-Control Workshop, 1986
[NASA-CP-2432] N88-17586
Design of supersonic Coanda jet nozzles N88-17599
COASTS
CTD observations in the coastal transition zone off northern California, 16-25 February 1987
[AD-A187263] N88-18111
Numerical simulations of the California current: Filament formation as related to baroclinic instability
[AD-A187573] N88-18115
COATINGS
Los Alamos optical materials reliability, maintainability, and exposure testing program
[DE88-001953] N88-18404
COAXIAL CABLES
Measurement of shielding effectiveness of different cable and shielding configurations by mode-stirred techniques
[PB88-155791] N88-17885
COBALT ALLOYS
Effects of ion implantation on cavitation erosion of a cobalt based metal/carbide alloy
[AD-A187239] N88-17793
CODERS
Experience with Omega: Implementation of a prototype programming environment, part 6
[AD-A187080] N88-18270
CODING
A transonic-small-disturbance wing design methodology
[NASA-TP-2806] N88-17614
Designing variable-length codes with good error-recovery properties
[BBC-RD-1987/19] N88-17876
The design of trellis codes for fading channels
[NASA-CR-182523] N88-17891
Orthogonal patterns in binary neural networks
[NASA-TM-100060] N88-18320
COGNITION
A hypertext writing environment and its cognitive basis
[AD-A188179] N88-18298
COLD WORKING
Computed stress and strain distributions under interference fit and after coldworking
[AD-A186950] N88-18024
COLLIMATION
Systolic array adaptive beamforming
[AD-A187496] N88-18269
COLLISIONLESS PLASMAS
A study of single and binary ion plasma expansion into laboratory-generated plasma wakes
[NASA-CR-4125] N88-18427
Plasma theory and simulation
[DE88-003620] N88-18437
COLLOCATION
Domain decomposition preconditioners for the spectral collocation method
[NASA-CR-181620] N88-18345
COLLOIDS
Electron transfer to iron(3) oxide colloids
[DE88-002685] N88-18448
COLUMBUS SPACE STATION
Study on long term evolution towards European manned space flight. Volume 1: Executive summary
[MBB-RA3-004/87-VOL-1] N88-17689
Project management in astronautics: From Spacelab to Columbus
[MBB-URE-943/87] N88-17858
COMBAT
Future fighter maneuverability for air combat
[MBB/LKE-1/S/PUB/120] N88-17843
Hardware implementation for special functions. An application for combat simulation N88-18197
Future directions in computer architecture
N88-18257
COMBUSTIBLE FLOW
Turbulence interactions in single- and multi-phase turbulent mixing and combustion processes
[AD-A187505] N88-17960
COMBUSTION
Diffusion description of flame propagation due to the translational motion of burning reaction products
[DE88-700676] N88-17757
The role of analytical chemistry in assessing atmospheric effects of combustion
[DE88-003909] N88-18082

COMBUSTION CHAMBERS
Numerical simulation of axisymmetric turbulent flow in combustors and diffusors
[NASA-CR-4115] N88-17582
Numerical simulation of diffuser/combustor dome interaction N88-17663
COMBUSTION PRODUCTS
CARS measurements of combustion. 1: Precision of thermometry
[NAL-TR-939] N88-17769
The role of analytical chemistry in assessing atmospheric effects of combustion
[DE88-003909] N88-18082
COMETARY ATMOSPHERES
Extended atmospheres of outer planet satellites and comets
[NASA-CR-181449] N88-18540
COMMAND AND CONTROL
Future directions in computer architecture N88-18257
COMMUNICATION
Helsinki University of Technology Communications Laboratory
[PB88-112974] N88-17881
The design of trellis codes for fading channels
[NASA-CR-182523] N88-17891
Future directions in computer architecture N88-18257
Networking requirements and future alternatives
[NASA-TM-89711] N88-18517
COMMUNICATION CABLES
Failure-resistant Fibre-Optical Communication Line (FOCL)
[DE88-700470] N88-18400
COMMUNICATION SATELLITES
Satellite interference analysis and simulation using personal computers
[NASA-CR-182522] N88-17890
COMPARISON
Supercomputer performance: The theory, practice, and results
[DE88-004697] N88-18266
Parallels between control PDE's (Partial Differential Equations) and systems of ODE's (Ordinary Differential Equations)
[NASA-CR-182487] N88-18331
A comparison of projection methods in the forecasting of overhead costs for seven government aerospace contractors
[AD-A187572] N88-18514
COMPENSATION
Transport delay compensation for computer-generated imagery systems
[NASA-TM-100084] N88-17645
COMPILERS
Programming language translation for multicomputers N88-18244
Design for a TPL compiler system: A system for retargeting high level language programs N88-18248
Factors causing unexpected variations in Ada benchmarks
[AD-A187231] N88-18291
Loop coalescing: A compiler transformation for parallel machines
[DE88-003571] N88-18307
Performance and evaluation at the Center for Supercomputing Research and Development
[DE88-003563] N88-18456
COMPLEXITY
Machine models and simulations
[PB88-118690] N88-18280
COMPONENT RELIABILITY
A strategy for failure prediction N88-18243
COMPOSITE MATERIALS
Automated Composites, First International Conference, September 10-12, 1986, University of Nottingham, England
[PB87-126199] N88-17734
Composite materials for rail transit systems
[NASA-CR-178401] N88-17738
Short fiber reinforced thermoplastic composites for armor applications: Interfacial bonding
[DE88-004007] N88-17742
A finite element analysis of adhesively bonded composite joints including geometric nonlinearity, nonlinear viscoelasticity moisture diffusion and delayed failure
[AD-A187455] N88-17747
The analysis of deformations and strains in composites by moire interferometry
[AD-A187482] N88-18043
Ultrasonic characterization of layered composite systems N88-18374
The effect of magnetic impurities and barriers on the magnetization and critical current of fine filament NbTi composites
[DE88-004443] N88-18472
COMPOSITE STRUCTURES
Rotorcraft weight trends in light of structural material characteristics
[AD-A186576] N88-17642
A finite element analysis of adhesively bonded composite joints including geometric nonlinearity, nonlinear viscoelasticity moisture diffusion and delayed failure
[AD-A187455] N88-17747
COMPRESSIBILITY EFFECTS
Investigation of dihedral effects in compressor cascades N88-17672
COMPRESSIBLE FLOW
Lifting-surface theory of oscillating propellers in compressible flow
[NAL-TR-943] N88-17613
A numerical study of unsteady two-dimensional subsonic compressible base flow N88-17931
COMPRESSIVE STRENGTH
Effect of post-cure heat-treatment on static and fatigue behaviour of XAS-914C carbon fibre composite
[AD-A186943] N88-17735
Strength and structure of Ga sub 1-xIn sub xAs alloys
[AD-A188092] N88-17795
COMPRESSOR BLADES
Operation of gas turbine engines in dust-laden environments N88-17654
Radial compressor design using an Euler solver N88-17675
Secondary flow measurements with L2F-technique in centrifugal compressors N88-17676
Design and testing of a front stage for an advanced high pressure compressor N88-17679
Experimental investigation of a supercritical compressor rotor blade section N88-17680
Computation of secondary flows in an axial multistage compressor N88-17681
COMPRESSOR EFFICIENCY
Method for predicting performance limits of centrifugal compressors N88-17677
Analysis of the performance of an air-water heat pump: Regulation of intrinsic performances
[DE88-900241] N88-18061
COMPRESSORS
Computation of secondary flows in an axial multistage compressor N88-17681
COMPUTATION
A computational study of thrust augmenting ejectors based on a viscous-inviscid approach N88-17929
Annotated computer output for split plot design: GENSTAT ANOVA
[AD-A187120] N88-18271
Machine models and simulations
[PB88-118690] N88-18280
The effects of data structure on total time on test plots
[AD-A187628] N88-18296
Recent progress in the p and h-p version on the finite element method
[AD-A187254] N88-18347
COMPUTATIONAL FLUID DYNAMICS
Solution of the three-dimensional Navier-Stokes equations for transonic flow using a multigrid method N88-17579
Application of empirical and linear methods to VSTOL powered-lift aerodynamics
[NASA-TM-100048] N88-17581
Wall jet analysis for circulation control aerodynamics. Part 1: Fundamental CFD and turbulence modeling concepts N88-17588
Transonic blade design on rotational stream surfaces N88-17671
Computation of secondary flows in an axial multistage compressor N88-17681
Shuttle rocket booster computational fluid dynamics
[NASA-CR-182518] N88-17733
Boundary layer calculation using digital computers
[REPT-MM-4] N88-17821
Zonal solutions for viscous flow problems. Finite approximations in fluid mechanics
[MBB/LKE-122/S/PUB/226] N88-17846
The use of multigrid techniques in the solution of the Elrod algorithm for a dynamically loaded journal bearing
[NASA-CR-180873] N88-17954
A visual programming environment for the Navier-Stokes computer
[NASA-CR-181615] N88-18299
Hypersonic blunt body computations including real gas effects
[NASA-TM-100074] N88-18344
COMPUTATIONAL GRIDS
Implicit solution of the incompressible Navier-Stokes equations in primitive variables on non-staggered grids N88-17930
The use of multigrid techniques in the solution of the Elrod algorithm for a dynamically loaded journal bearing
[NASA-CR-180873] N88-17954
Schwarz splitting and template operators
[AD-A187956] N88-18370
COMPUTER AIDED DESIGN
A generalized method for automatic downhand and wirefeed control of a welding robot and positioner
[NASA-TP-2807] N88-17869
Optimal design and parameter identification of flexible rotor-bearing systems N88-18002
Directions in computer graphics architecture N88-18233
Computer aided geometric design
[AD-A187324] N88-18293
Development of tokamak reactor system analysis code NEW-TORSAC
[DE88-751067] N88-18417
Computer-Aided Design Information System (CADIS): User's manual
[DE88-004365] N88-18509
COMPUTER AIDED MANUFACTURING
A generalized method for automatic downhand and wirefeed control of a welding robot and positioner
[NASA-TP-2807] N88-17869
COMPUTER AIDED TOMOGRAPHY
The development of emission tomography for the nuclear industry
[AERE-R-12319] N88-18014
COMPUTER COMPONENTS
Chips: A tool for developing software interfaces interactively
[AD-A187499] N88-18295
COMPUTER DESIGN
Annotated computer output for split plot design: GENSTAT ANOVA
[AD-A187120] N88-18271
COMPUTER GRAPHICS
Directions in computer graphics architecture N88-18233
Personal computers and All-In-1: Document transfer and translation
[DE88-003760] N88-18264
Graph transformation algorithms for array memory optimization in applicative languages
[DE88-004727] N88-18283
CUEMAP: A tool for generating hierarchical charts and dataflow diagrams
[DE88-004778] N88-18284
Chips: A tool for developing software interfaces interactively
[AD-A187499] N88-18295
Development of tokamak reactor system analysis code NEW-TORSAC
[DE88-751067] N88-18417
COMPUTER INFORMATION SECURITY
A framework for evaluating computer architectures to support systems with security requirements, with applications
[AD-A187082] N88-18303
COMPUTER NETWORKS
Multiple-bus interconnection for future multiprocessor systems N88-18203
An anlysis of the reliability of tree-structured interconnection networks N88-18228
A strategy for failure prediction N88-18243
Future directions in computer architecture and software workshop N88-18258
Personal computers and All-In-1: Document transfer and translation
[DE88-003760] N88-18264
An Ethernet local area network controller with supporting operating system software
[DE88-003534] N88-18304
The Lambda network: A new permutation network
[DE88-003568] N88-18305
Shared workspaces for real-time collaboration in distributed networks: Concepts, techniques, problems
[AD-A188150] N88-18315
Guidelines for exchanging computerized information
[DE88-004736] N88-18510
Networking requirements and future alternatives
[NASA-TM-89711] N88-18517
COMPUTER PROGRAMMING
Image texture classification with an optical crossbar interconnected processor N88-18202
Predicate analysis for parallel program generation N88-18222
Software support for heterogeneous machines N88-18224
Semi-applicative programming N88-18239

An applicative programmer's approach to matrix algebra, lessons for hardware and software N88-18251
Implementing logical variables on a graph reduction architecture N88-18252
Experience with Omega: Implementation of a prototype programming environment, part 6 [AD-A187080] N88-18270
Using program structure to achieve prefetching for cache memories [DE88-003599] N88-18282
Programming methodology and performance issues for advanced computer architectures [DE88-003098] N88-18287
Development of a graphics based two-attribute utility assessment program with application to mission planning [AD-A187276] N88-18292
Deriving abstractions from a software object network [AD-A187472] N88-18294
Performance studies of a parallel processor for large linear programming problems [PB88-121611] N88-18310

COMPUTER PROGRAMS
Investigation of dynamic stall using LDV (Laser Doppler Velocimetry): Mean flow studies [AD-A187629] N88-17611
A transonic-small-disturbance wing design methodology [NASA-TP-2806] N88-17614
Transport delay compensation for computer-generated imagery systems [NASA-TM-100084] N88-17645
Shuttle rocket booster computational fluid dynamics [NASA-CR-182518] N88-17733
Satellite interference analysis and simulation using personal computers [NASA-CR-182522] N88-17890
A ring model of the lasertron [DE88-004656] N88-17908
Signal processing studies program VLSI designs for unary functions [AD-A188053] N88-17922
NF85: A three-dimensional, air-dynamics computer code for analyzing explosions in structures [DE88-005085] N88-17953
AEV local verification for aviation, precipitation and temperature programs: AV, REL, TEM (September 1987 revision) [PB88-115662] N88-18101
Proceedings of the Workshop on Future Directions in Computer Architecture and Software [AD-A184949] N88-18191
Why reusable software isn't N88-18212
Future directions in computer architecture and software: The year 2000 N88-18218
Systolic array adaptive beamforming [AD-A187496] N88-18269
Annotated computer output for split plot design: GENSTAT ANOVA [AD-A187120] N88-18271
CUEMAP: A tool for generating hierarchical charts and dataflow diagrams [DE88-004778] N88-18284
Semantics of EqL [AD-A188151] N88-18297
The Lambda network: A new permutation network [DE88-003568] N88-18305
Development of tokamak reactor system analysis code NEW-TORSAC [DE88-751067] N88-18417

COMPUTER STORAGE DEVICES
An efficient sparse matrix multiplication scheme for the CYBER 205 computer [NASA-TM-4028] N88-18302
Performance and evaluation at the Center for Supercomputing Research and Development [DE88-003563] N88-18456
Optical memory cards: A comparison with other current technologies and potential military applications [AD-A187287] N88-18512

COMPUTER SYSTEMS DESIGN
An advanced microcomputer design for processing of semiconductor materials N88-17703
Inexpensive solution for the mass distribution of satellite images [PB88-114038] N88-17873
Proceedings of the Workshop on Future Directions in Computer Architecture and Software [AD-A184949] N88-18191
Some further observations about reduced instruction set computers N88-18192
An empirical analysis of the Lilith instruction set N88-18193
High-performance CPU implementation of the nebula instruction set architecture N88-18194
The design of ultra high-speed numeric intensive systems (having fault tolerant and load balancing capabilities) N88-18196
Research and development trends for memory hierarchies — cache memories N88-18198
On parallelism in software/hardware design tools N88-18200
A large-grain dataflow architecture N88-18207
Towards reusable software designs and implementations N88-18213
The case for a shared address space N88-18225
Design for a TPL compiler system: A system for retargeting high level language programs N88-18248

COMPUTER SYSTEMS PERFORMANCE
Proceedings of the Workshop on Future Directions in Computer Architecture and Software [AD-A184949] N88-18191
Hardware implementation for special functions. An application for combat simulation N88-18197
A comparative study of heurstic algorithms for task assignment in distributed computing systems N88-18211
A paradigm for concurrency control performance evaluation N88-18220
A strategy for failure prediction N88-18243
Parallelism at the microlevel: Cooperative microcontrollers with real time considerations N88-18246
Design for a TPL compiler system: A system for retargeting high level language programs N88-18248
A measurement-based study of concurrency in a multiprocessor [DE88-003536] N88-18260

COMPUTER SYSTEMS PROGRAMS
An empirical analysis of the Lilith instruction set N88-18193
Experimenting with parallel programing in logic N88-18240
Real time artificial intelligence architecture N88-18242
Experience with Omega: Implementation of a prototype programming environment, part 6 [AD-A187080] N88-18270
Factors causing unexpected variations in Ada benchmarks [AD-A187231] N88-18291
Deriving abstractions from a software object network [AD-A187472] N88-18294
An Ethernet local area network controller with supporting operating system software [DE88-003534] N88-18304

COMPUTER TECHNIQUES
Application of ac-impedance method on determination of corroeion rate of metals [DE88-750307] N88-17771
Methods of eliciting information from experts [AD-A187468] N88-18189
Deriving abstractions from a software object network [AD-A187472] N88-18294

COMPUTER VISION
An overview of vision-based navigation for autonomous land vehicles 1986 [AD-A188186] N88-17640

COMPUTERIZED SIMULATION
Radar returns from ground clutter in vicinity of airports N88-17624
Wind shear radar simulation N88-17625
Simulator investigation of wind shear recovery techniques N88-17630
Numerical simulation of diffuser/combustor dome interaction N88-17663
Simulation test beds for the space station electrical power system [NASA-TM-100786] N88-17715
ESL batteries and multi-segment applications — ESA Simulation Language (ESL) [CS-1029/00-QFIN4] N88-17901
Multidimensional modeling of convective heat transfer with application to IC engines [DE88-003398] N88-17948
Emittance studies at the Los Alamos National Laboratory Free-Electron Laser (FEL) [DE88-003146] N88-17975
Instrumentation and quantitative methods of evaluation [DE87-013639] N88-18017
Simulation and modeling of whistler mode wave growth through cyclotron resonance with energetic electrons in the magnetosphere N88-18089
Numerical simulations of the California current: Filament formation as related to baroclinic instability [AD-A187573] N88-18115
Hardware implementation for special functions. An application for combat simulation N88-18197
Parallel discrete event simulation: A shared memory approach [NASA-CR-182521] N88-18312
Microscopic modeling of sound waves in granular material [DE88-000348] N88-18375
The numerical simulation of accelerator components [DE87-011597] N88-18423
Benchmarks of neutral beam injection codes for stellarators [DE88-003786] N88-18428
Plasma theory and simulation [DE88-003620] N88-18437
Simulation and processing of high resolution images of defects and interfaces in superconducting YBa2Cu3O7 [DE88-003856] N88-18480
Cosmic strings: A problem or a solution [DE88-003410] N88-18535

COMPUTERS
A visual programming environment for the Navier-Stokes computer [NASA-CR-181615] N88-18299
Relaxing the brightness constancy assumption in computing optical flow [AD-A187437] N88-18410

CONCENTRATION (COMPOSITION)
An infra-red investigation of HAN (Hydroxylammonium Nitrate)-based liquid propellants [AD-A187226] N88-17815

CONCENTRATORS
Solar concentrator advanced development program, task 1 [NASA-CR-179489] N88-18068
Side-by-side comparisons of evacuated compound parabolic concentrator and flat plate solar collector systems at temperatures of 90 to 100°C [DE88-004717] N88-18073

CONCURRENT PROCESSING
SISAL: Initial MIMD performance results N88-18208
A paradigm for concurrency control performance evaluation N88-18220
Concurrency control and reliability in replicated database systems N88-18221
Strategies for concurrent processing of complex algorithms N88-18236
Resilient procedures: A structured replication approach N88-18245

CONDITIONING (LEARNING)
Short- and long-term effects of nonlethal levels of fast high-energy helium ions on retention of developed and formation of new behavioral patterns in rats N88-18140

CONDUCTIVE HEAT TRANSFER
Approximate solutions of heat conduction in a medium with variable properties [AD-A186933] N88-17925

CONFERENCES
Airborne Wind Shear Detection and Warning Systems: First Combined Manufacturers' and Technologists' Conference [NASA-CP-10006] N88-17616
Advanced Technology for Aero Gas Turbine Components [AGARD-CP-421] N88-17647
High resolution electron and ion microscopy [AERE-R-12502] N88-17754
Second All-Union Conference on Physiology of Extreme States and Individual Protection of Man N88-18147
Minutes of the meeting of the Indo-US Subcommission on Science and Technology (8th) held at Washington, D.C. on September 22-24, 1986 [PB88-130158] N88-18503

CONFIGURATIONS
Automatically reconfigurable computer architecture N88-18204

CONFORMAL MAPPING
Centerplane source distribution for slender bodies N88-17940

CONICAL BODIES
Control of vortical separation on conical bodies N88-17580

CONJUGATE GRADIENT METHOD
Conjugate gradient spectral iterative technique [PB88-126917] N88-18337
Polynomial preconditioning for conjugate gradient methods [DE88-005214] N88-18342

CONSERVATION LAWS
A study of numerical methods for hyperbolic conservation laws with stiff source terms [NASA-TM-100075] N88-18343

CONTAINERLESS MELTS
Non-proprietary research projects of the Center for the Space Processing of Engineering Materials [AR-2] N88-18516

CONTINENTAL SHELVES
Trace element geochemistry of the South Atlantic Bight
[DE88-003515] N88-18108
Coordination: Southeast continental shelf studies
[DE88-003680] N88-18110
CONTINENTS
Numerical studies of propagation of Lg waves across ocean continent boundaries using the Representation Theorem (RT) N88-18085
CONTINUITY (MATHEMATICS)
Estimation of gravity vector components from Bell gravity gradiometer and auxiliary data under consideration of topography and associated analytical upward continuation aspects
[AD-A188146] N88-18099
CONTINUOUS RADIATION
A technique for low level, wide range CW microwave power meter calibrations
[DE88-004147] N88-17966
CONTINUOUS WAVE LASERS
Instabilities and chaos in a multimode, standing-wave, CW dye laser
[DE88-005028] N88-17993
CONTRACTORS
A method for assessing the software engineering capability of contractors: Preliminary version
[AD-A187230] N88-18290
A comparison of projection methods in the forecasting of overhead costs for seven government aerospace contractors
[AD-A187572] N88-18514
CONTROL SIMULATION
Preliminary design of the ORION attitude control system
[AD-A187179] N88-17729
Perception and control of simulated self motion
[AD-A187444] N88-18188
CONTROL STABILITY
Microscopic control of metallization stability
[AD-A187553] N88-18487
CONTROL SURFACES
Effectiveness of various control surfaces in quasi-steady and unsteady conditions
[AGARD-R-735] N88-17682
CONTROL SYSTEMS DESIGN
The impact of circulation control on rotary aircraft controls systems N88-17601
Sensitivity of active vibration control to structural changes and model reduction N88-17683
An application of eigenspace methods to symmetric flutter suppression
[NASA-CR-181618] N88-17684
Light Electronic Control System (LECOS): A proposal for a interconnected error-tolerant, optoelectronic control system
[MBB-UT-004/87] N88-17836
Active control technology with adaptive control concept in the aircraft construction
[MBB/LKE-294/S/PUB/295] N88-17845
Local bifurcation control
[AD-A187435] N88-17915
Joint services electronics program
[AD-A187587] N88-17920
NASA/NBS (National Aeronautics and Space Administration/National Bureau of Standards) standard reference model for Telerobot Control System Architecture (NASREM)
[PB88-124773] N88-17999
Study on a rotor speed control system for a horizontal axis windmill
[NAL-TR-931] N88-18062
Parallels between control PDE's (Partial Differential Equations) and systems of ODE's (Ordinary Differential Equations)
[NASA-CR-182487] N88-18331
On observer problems for systems governed by partial differential equations
[AD-A187430] N88-18351
CONTROL THEORY
Boundary stabilization of thin elastic plates
[AD-A187123] N88-18025
Nonlinear filtering and large deviations: A PDE-Control theoretic approach
[AD-A187436] N88-18321
Boundary value problems for differential and functional differential equations
[AD-A187378] N88-18349
Viscosity methods in optimal control of distributed systems
[AD-A188086] N88-18357
CONTROLLERS
Pumping systems and flow interfaces for rapid response electronic reheat controls N88-17665
Possibilities for on-line surge suppression by fast guide vane adjustment in axial compressors N88-17674
Optically controlled devices and ultrafast laser sources for signal processing
[AD-A187417] N88-17995
An Ethernet local area network controller with supporting operating system software
[DE88-003534] N88-18304
The implementation of artificial intelligence in control systems
[DE88-003497] N88-18318
The representation of knowledge within model-based control systems
[DE88-004863] N88-18319
CONVECTION
Influence of convection on microstructure
[NASA-CR-182489] N88-17784
Periodic natural convection in a rectangular enclosure of low aspect ratio N88-17941
A multigrid preconditioner applied to a two-dimensional convection-diffusion problem
[DE88-004765] N88-18329
CONVECTIVE FLOW
A payload for investigating the influence of convection on GaAs crystal growth N88-17702
CONVECTIVE HEAT TRANSFER
Interferometric study of natural convection heat transfer from a vertical flat plate with transverse roughness elements N88-17935
Multidimensional modeling of convective heat transfer with application to IC engines
[DE88-003396] N88-17948
CONVERGENCE
A multigrid preconditioner applied to a two-dimensional convection-diffusion problem
[DE88-004765] N88-18329
The convergence rate for the strong law of large numbers: General lattice distributions
[AD-A187560] N88-18362
Probability bounds for M-Skorohod oscillations
[AD-A187981] N88-18371
CONVOLUTION INTEGRALS
Small degree solutions for the polynomial Bezout equation
[AD-A187630] N88-18355
COOLING
Mechanistic model for void distribution in flashing flow
[DE88-002948] N88-17928
COOLING SYSTEMS
Advanced techniques employed in blade cooling research N88-17659
COORDINATES
Evaluation of magnetic coordinates in finite-beta, asymmetric plasmas
[DE88-003665] N88-18424
COORDINATION
Hydrogen Energy Coordinating Committee: Summary of DOE hydrogen programs for FY 1987
[DE88-003960] N88-17811
COPLANARITY
Modeling of some coplanar waveguide discontinuities
[NASA-TM-100808] N88-17880
COPPER
Growth and electronic properties of strained metal overlayers
[DE87-010956] N88-18463
COPPER SULFIDES
Electrically conducting polymer-copper sulphide composite films, preparation by treatment of polymer-copper (2) acetate composites with hydrogen sulfide
[NASA-TT-20204] N88-17803
CORE SAMPLING
Data-base of Antarctic pre-Pleistocene sediment cores
[PB88-124151] N88-18094
CORNER FLOW
Experimental evaluation of turning vane designs for high-speed and coupled fan-drive corners of 0.1-scale model of NASA Lewis Research Center's proposed altitude wind tunnel
[NASA-TP-2681] N88-17686
CORNERS
Corner compensation structures for (110) oriented silicon
[DE88-003300] N88-18455
CORONARY ARTERY DISEASE
Relationships between coronary heart disease risk factors and serum ionized calcium in Kennedy Space Center Cohort
[NASA-TM-100979] N88-18177
CORONAS
Extended atmospheres of outer planet satellites and comets
[NASA-CR-181449] N88-18540
CORRELATION
Correlated processes in atomic collisions
[DE88-003508] N88-18383
CORROSION
Materials processing in space: An introduction to the G-480 payload N88-17695
Application of ac-impedance method on determination of corrosion rate of metals
[DE88-750307] N88-17771
Environment assisted degradation mechanisms in aluminum-lithium alloys
[NASA-CR-182482] N88-17782
A review of pitting corrosion in high temperature aqueous solutions
[DE88-003547] N88-17787
Corrosion behavior of sputter-deposited aluminum-based alloys exposed to chloride solutions
[AD-A187262] N88-17794
Investigation of materials for inert electrodes in aluminum electrodeposition cells
[DE88-003380] N88-17906
CORROSION RESISTANCE
Effect of low-temperature aging on the mechanical properties of cast stainless steels
[DE88-002872] N88-17774
Studies of the initiation of pitting corrosion on stainless steels
[AERE-M-3615] N88-17778
CORROSION TESTS
Corrosion and deterioration testing in humid tropic environments
[AD-A186917] N88-17783
COSMOLOGY
Qualitative methods in nonhomogeneous cosmology
[DE88-700620] N88-18458
Quark matter in astrophysics and cosmology
[DE88-003406] N88-18534
Cosmic strings: A problem or a solution
[DE88-003410] N88-18535
Velocity reversal and the arrows of time
[DE88-004237] N88-18536
COSMONAUTS
Present stage of space medicine N88-18151
Results of long-term electrocardiographic monitoring of cosmonauts N88-18152
COST ANALYSIS
Cape Blanco wind farm feasibility study
[DE88-003748] N88-18059
Cape Blanco wind farm feasibility study
[DE88-003749] N88-18060
COST EFFECTIVENESS
Evaluation of bituminous materials used in pavement recycling projects at Tyndall, MacDill, and Hurlburt Air Force Bases
[AD-A188068] N88-17871
Analysis of the performance of an air-water heat pump: Regulation of intrinsic performances
[DE88-900241] N88-18061
COST ESTIMATES
A comparison of projection methods in the forecasting of overhead costs for seven government aerospace contractors
[AD-A187572] N88-18514
COUNTER ROTATION
Secondary flow measurements with L2F-technique in centrifugal compressors N88-17676
COUNTING
Performance of a photon counting microchannel plate intensifier with wedge and strip image readout
[DE88-003831] N88-17970
COUPLING
Experimental evaluation of turning vane designs for high-speed and coupled fan-drive corners of 0.1-scale model of NASA Lewis Research Center's proposed altitude wind tunnel
[NASA-TP-2681] N88-17686
Dynamics of coupled electron-nucleon motion in a laser field
[DE88-005063] N88-17994
The dynamics of two coupled rigid bodies
[AD-A187592] N88-18012
Piezoelectric laminates for torsional and bending model control: Theory and experiment N88-18029
The dynamics of coupled planar rigid bodies. Part 1: Reduction, equilibria and stability
[AD-A187467] N88-18042
Application of a multigrid method to a buoyancy-induced flow problem
[DE88-003961] N88-18326
COVARIANCE
Five-diagonal weighting scheme for geoidal profiles
[AD-A188033] N88-18054
CRAB NEBULA
Gamma-ray imaging observations of the Crab and Cygnus regions N88-18522
CRACK GEOMETRY
Scattering of impulsive acoustic waves by a semi-infinite crack in the plane interface of a half-space and a layer
[PB88-126396] N88-18377

CRACK PROPAGATION
Analytical and experimental characterization of damage processes in composite laminates
[AD-A187221] N88-17746
Mechanisms of intergranular attack and stress corrosion cracking of alloy 600 by high-temperature caustic solutions containing impurities
[DE87-012820] N88-17773
Some aspects of the mechanics and mechanisms of dynamic brittle fracture N88-18028
Theoretical analysis of adhesive fracture and crack-damage interactions N88-18030
Fatigue crack growth due to random loading
[DE88-004641] N88-18038
Brittle to ductile transition to cleavage fracture
[DE88-004074] N88-18481

CRACKS
Analytical and experimental characterization of damage processes in composite laminates
[AD-A187221] N88-17746
A detailed microstructural examination of the cause of HAZ cracking in type 316 steel
[AERE-R-12428] N88-17777
Durability and damage tolerance of aluminum castings
[AD-A186444] N88-18013
Theoretical analysis of adhesive fracture and crack-damage interactions N88-18030
Fatigue crack growth due to random loading
[DE88-004641] N88-18038
Brittle to ductile transition to cleavage fracture
[DE88-004074] N88-18481

CRAY COMPUTERS
Vector performance of register-to-register vector computers
[DE88-004013] N88-18265

CREATIVITY
Innovation and creativity: A critical linkage
[DE88-003309] N88-18515

CREEP PROPERTIES
The role of composition and microstructure gradients on weld metal properties and behavior
[DE88-004956] N88-17791
Relationship between fatigue life in the creep-fatigue region and stress-strain response
[NASA-TM-100796] N88-18040

CRITICAL VELOCITY
On the role of the ionization frequency to gyrofrequency ratio in the critical ionization velocity interaction
[TRITA-EPP-86-10] N88-18414

CROP VIGOR
Species biology and potential for controlling four exotic plants (Ammophila arenaria, Carpobrotus edulis, Cortaderia jubata and Gasoul crystallinum) on Vandenberg Air Force Base, California
[NASA-TM-100980] N88-18148

CROSS FLOW
Control of vortical separation on conical bodies N88-17580
Leeside crossflow modeling in Euler space-marching computations
[NASA-TM-89710] N88-17924
Investigation of non-symmetric jets in cross flow N88-17932
Time-resolved heat transfer measurements and analysis in the wage region of a cylinder in crossflow N88-17939

CRYOGENIC COOLING
Study of helium transfer technology for STICCR: Fluid management
[NASA-CR-177463] N88-17720
Low-noise cryogenically cooled broad-band microwave preamplifiers
[DE88-004561] N88-17912

CRYOGENIC ROCKET PROPELLANTS
STS propellant scavenging systems study. Part 2, volume 1: Executive summary and study results
[NASA-CR-179275] N88-17716
STS propellant scavenging systems study. Part 2, volume 2: Cost and WBS/dictionary
[NASA-CR-179276] N88-17717

CRYOGENICS
Cryogenic acoustic microscopy
[AD-A187274] N88-17767

CRYSTAL DEFECTS
Models for ionic transport in glass
[DE88-002860] N88-17799
Positron-annihilation 2D-ACAR studies of disordered and defected alloys
[DE88-003118] N88-18454
Solving complex and disordered surface structures with electron diffraction
[DE88-003863] N88-18467
Grazing incidence X-ray scattering study of defect structures in MBE GaAs/Si using synchrotron radiation
[DE88-004556] N88-18483

CRYSTAL GROWTH
Electrochemical growth of linear conducting crystals in microgravity N88-17698
Protein-crystal growth experiment (planned) N88-17700
A payload for investigating the influence of convection on GaAs crystal growth N88-17702
An advanced microcomputer design for processing of semiconductor materials N88-17703
Application of Hoffman modulation contrast microscopy coupled with three-wavelength two-beam interferometry to the in situ direct observation of the growth process of a crystal in microgravity N88-17704
Project Explorer takes its second step: GAS-608 in engineering development N88-17707
Formation of optical waveguides by ion implantation
[DE88-003894] N88-18407
High temperature processing of superconducting Y1Ba2Cu3O6.9
[DE88-003002] N88-18449
Growth and electronic properties of strained metal overlayers
[DE87-010956] N88-18463
Stability diagrams for epitaxial strained layers
[DE88-003935] N88-18470

CRYSTAL LATTICES
Fabrication, phase transformation studies and characterization of SiC-AlN-Al2OC ceramics
[DE88-004053] N88-17807
Study of quantum mechanical effects in deep submicron, grating-gate field effect transistors
[AD-A188283] N88-17923
Optical characterization of GaAs/sub 1-x/Sb/sub x/ and GaAs/sub 1-x/Sb/sub x/GaAs strained layer superlattices
[DE88-003393] N88-18464

CRYSTAL STRUCTURE
Corner compensation structures for (110) oriented silicon
[DE88-003300] N88-18455
Growth and electronic properties of strained metal overlayers
[DE87-010956] N88-18463
Solving complex and disordered surface structures with electron diffraction
[DE88-003863] N88-18467
Order-disorder transition of Au and Pt (110) surfaces: The significance of relaxations and vibrations
[DE88-004651] N88-18473

CRYSTAL SURFACES
Laser pulse width dependent surface ripples on silicon
[PB88-127311] N88-17982

CRYSTALLIZATION
Protein-crystal growth experiment (planned) N88-17700

CRYSTALS
Recent progress in the dynamic applications of piezoelectric crystals N88-18460
The structure and properties of twin boundaries in superconducting YBa2Cu3O7
[DE88-003864] N88-18468

CULTURE TECHNIQUES
Research on a solar biotechnology based on the culture of photosynthetic cells
[DE88-900129] N88-18120

CURIE TEMPERATURE
Spin disorder resistivity and bare Curie temperature in the ferromagnetic superconductor ErRh4B4
[DE88-003016] N88-18445

CURING
Effect of post-cure heat-treatment on static and fatigue behaviour of XAS-914C carbon fibre composite
[AD-A186943] N88-17735

CURRENT DENSITY
Application of ac-impedance method on determination of corrosion rate of metals
[DE88-750307] N88-17771
Investigation of materials for inert electrodes in aluminum electrodeposition cells
[DE88-003380] N88-17906

CURRENT SHEETS
A study of the magnetic field annihilation process in the magnetosphere and some geotechnical applications
[DE88-004165] N88-18096

CURVATURE
The deposition rate dependence of plasma polymerization on the radius of curvature of the substrate
[DE88-003811] N88-18429

CURVE FITTING
Using frequency-domain methods to identify XV-15 aeroelastic modes
[NASA-TM-100033] N88-17646

CURVES (GEOMETRY)
Computation of the zeta-function of an algebraic curve with the differentials of the first kind
[PB88-127527] N88-18339

CYANOGEN
Laser studies of the dynamics of free radical reactions
[DE88-004431] N88-17989

CYCLOGENESIS
The structure and dynamics of monsoon depressions N88-18102

CYCLOTRON FREQUENCY
Fundamental cyclotron frequency generation from a cusptron oscillator
[AD-A188187] N88-17898

CYCLOTRON RESONANCE
Simulation and modeling of whistler mode wave growth through cyclotron resonance with energetic electrons in the magnetosphere N88-18089
Application of ECR ion source beams in atomic physics
[DE88-003767] N88-18384
ATF experimental plans
[DE88-004177] N88-18439

CYCLOTRON RESONANCE DEVICES
First and second harmonic ECRH experience at gyrotron frequencies at LLNL
[DE88-003996] N88-18430

CYGNUS CONSTELLATION
Gamma-ray imaging observations of the Crab and Cygnus regions N88-18522

CYLINDRICAL BODIES
An analytical study of the effects of transverse shear deformation and anisotropy on natural vibration frequencies of laminated cylinders
[NASA-TM-100554] N88-17739
The numerical and analytical study of bifurcation and multicellular flow instability due to natural convection between narrow horizontal isothermal cylindrical annuli at high Rayleigh numbers N88-17937

CYTOGENESIS
Investigation of genetic structures of rat germ cells following flight aboard Cosmos-1514 biosatellite during their prenatal development N88-18155

D

DAMAGE
Analytical and experimental characterization of damage processes in composite laminates
[AD-A187221] N88-17746
Relationship between fatigue life in the creep-fatigue region and stress-strain response
[NASA-TM-100796] N88-18040
Modeling of the non-auditory response to blast overpressure
[AD-A187397] N88-18184

DAMAGE ASSESSMENT
A chemical precursor to optical damage. Studies by laser ionization mass spectrometry
[DE88-004321] N88-18408

DAMPING
Active control technology with adaptive control concept in the aircraft construction
[MBB/LKE-294/S/PUB/295] N88-17845

DARKNESS
The accommodative status in the dark of US Navy fighter pilots
[AD-A188188] N88-18186

DATA ACQUISITION
A reliable data collection/control system N88-17708
Speech recognition: Acoustic-phonetic knowledge acquisition and representation
[AD-A187293] N88-17893
Evaluation of surface energy and radiation balance systems on the Konza Prairie
[NASA-CR-182534] N88-18097
Developments in National Weather Service meteorological data collection programs as related to EPA (Environmetal Protection Agency) air pollution models
[PB88-130240] N88-18104
Minimum Energy Routing through Interactive Techniques (MERIT) modeling
[NASA-CR-182535] N88-18105
Methods of eliciting information from experts
[AD-A187468] N88-18189
MICRO system for control, acquisition and processing of experimental data
[DE88-700724] N88-18278

DATA BASE MANAGEMENT SYSTEMS
Computer-Aided Design Information System (CADIS): User's manual
[DE88-004365] N88-18509

DATA BASES
Metal hydrides
[DE88-005083] N88-17766

Extension of nuclear structure data base searches for gamma-ray laser candidates
[DE88-004288] N88-17985
Data-base of Antarctic pre-Pleistocene sediment cores
[PB88-124151] N88-18094
A paradigm for concurrency control performance evaluation N88-18220
Concurrency control and reliability in replicated database systems N88-18221
Utilization of the JANAF (Joint Army Navy Air Force) database for chemical thermodynamic calculations
[DE88-004571] N88-18501

DATA CORRELATION
Unidimensional Rasch model and multidimensional data: An analytic approach
[PB88-105861] N88-18187

DATA FLOW ANALYSIS
Massive fine-grain parallelism in array computation: A data flow solution N88-18254
Automated data flow diagram verification N88-18255

DATA LINKS
Information transfer in the National Airspace System N88-17834
Design and implementation of a fiber optic RS232 link
[AD-A187319] N88-18409

DATA MANAGEMENT
Using SIR (Scientific Information Retrival) system for data management during a field program
[DE88-001555] N88-18508

DATA PROCESSING
Wide band data transmission system using optical fibers
[DE88-004555] N88-17889
Minimum Energy Routing through Interactive Techniques (MERIT) modeling
[NASA-CR-182535] N88-18105
A VLSI implementable block oriented data driven multiprocessor N88-18249
Data prefetching in shared memory multiprocessors
[DE88-003576] N88-18314

DATA REDUCTION
Multi-processor reduction machines N88-18253

DATA STORAGE
Data prefetching in shared memory multiprocessors
[DE88-003576] N88-18314

DATA STRUCTURES
Unidimensional Rasch model and multidimensional data: An analytic approach
[PB88-105861] N88-18187
Portable (and disposable) interpreters N88-18237
The effects of data structure on total time on test plots
[AD-A187628] N88-18296
Dynamic processor self-scheduling for general parallel nested loops
[DE88-003572] N88-18311

DATA TRANSFER (COMPUTERS)
Guidelines for exchanging computerized information
[DE88-004736] N88-18510

DATA TRANSMISSION
Information transfer in the National Airspace System N88-17834
Signal processing for an optical wide band data transmission system
[DE88-003854] N88-17888
Wide band data transmission system using optical fibers
[DE88-004555] N88-17889
Personal computers and All-In-1: Document transfer and translation
[DE88-003760] N88-18264
Failure-resistant Fibre-Optical Communication Line (FOCL)
[DE88-700470] N88-18400
Guidelines for exchanging computerized information
[DE88-004736] N88-18510

DAYGLOW
Theoretical and observational problems with Holes in the far UV dayglow
[AD-A188190] N88-18100

DECISION MAKING
Windshear training aid. Volume 1: Overview, pilot guide, training program
[PB88-127196] N88-17637
Real time artificial intelligence architecture N88-18242
Development of a graphics based two-attribute utility assessment program with application to mission planning
[AD-A187276] N88-18292
A two-stage isolated-word recognition system using discriminant analysis
[AD-A187425] N88-18360

DECOMPOSITION
A three-dimensional dual potential procedure for rotational flows N88-17942
A multiprocessor scheme for the singular value decomposition
[DE88-003591] N88-18288
Fast Poisson solver on irregular regions by boundary integral-based domain decomposition methods
[DE88-003583] N88-18340
Domain decompcesition preconditioners for the spectral collocation method
[NASA-CR-181620] N88-18345
High temperature processing of superconducting Y1Ba2Cu3O6.9
[DE88-003002] N88-18449

DEEP SPACE NETWORK
Deep space target location with Hubble Space Telescope (HST) and Hipparcos data
[NASA-CR-182520] N88-18524

DEFECTS
Acoustic emission measurements of PWR weld materials with inserted defects
[AERE-R-12386] N88-18016
Flaw identification from forced vibration testing
[DE88-002641] N88-18018
The influence of small defects on tensile specimen ductility and symmetry of deformation
[AD-A187983] N88-18044
Grain boundaries, planar defects and superconducting properties of YBa2Cu3O7
[DE88-003477] N88-18475
Simulation and processing of high resolution images of defects and interfaces in superconducting YBa2Cu3O7
[DE88-003856] N88-18480

DEFENSE INDUSTRY
The military techniques of tomorrow. A contribution to active peace assurance
[MBB-UA-1049/87] N88-17860

DEFENSE PROGRAM
Concurrency control and reliability in replicated database systems N88-18221

DEFORMATION
An analytical study of the effects of transverse shear deformation and anisotropy on natural vibration frequencies of laminated cylinders
[NASA-TM-100554] N88-17739
Micro-mechanisms of deformation in SiC/Al composites
[AD-A188282] N88-17749
Boundary integral analysis of flow and deformation of long bubbles in capillaries
[DE88-002110] N88-17927
Acoustic emission-microstructural relations in ferritic steels. Part 3: The effect of inclusion content
[AERE-R-12041] N88-18015
The analysis of deformations and strains in composites by moire interferometry
[AD-A187482] N88-18043
Continuous deformation algorithm on the product space of unit simplices, revised version
[PB88-114210] N88-18281
Stability diagrams for epitaxial strained layers
[DE88-003935] N88-18470

DEGRADATION
Operation of gas turbine engines in dust-laden environments N88-17654
Environment assisted degradation mechanisms in aluminum-lithium alloys
[NASA-CR-182482] N88-17782

DEHUMIDIFICATION
Experimental studies of heat and mass exchange in parallel-passage rotary desiccant dehumidifiers for solar cooling applications
[DE88-001119] N88-18069

DELAMINATING
A fiber-resin micromechanics analysis of the delamination front in a DCB specimen
[NASA-TM-100540] N88-17737
Cost 501 Project UK10 part 3: Thermal fatigue damage of Fecralloy steel-sprayed and co-extruded tubing
[AERE-R-12230] N88-18026

DELAY
A finite element analysis of adhesively bonded composite joints including geometric nonlinearity, nonlinear viscoelasticity moisture diffusion and delayed failure
[AD-A187455] N88-17747

DELTA WINGS
Supersonic aerodynamics of delta wings
[NASA-TP-2771] N88-17615

DENSE PLASMAS
New mode conversion process and overdense plasma heating in the electron cyclotron range of frequencies
[IPPJ-854] N88-18420

DEOXYRIBONUCLEIC ACID
Optimization of the southern electrophoretic transfer method
[DE88-004527] N88-17765
Effect of weightlessness on replicative function of rat hepatocyte DNA N88-18129

DEPOSITION
Corrosion behavior of sputter-deposited aluminum-based alloys exposed to chloride solutions
[AD-A187262] N88-17794
Adhesion of vapour phase deposited ultra-thin polyimide films on polycrystalline silver
[AD-A187930] N88-17810
The soft/hard wet anodization of aluminum oxide and its use in a thin film multilayered capacitor
[AD-A187575] N88-17919
Apparatus for the study of silicon film deposition and silicon etching
[AD-A187616] N88-17972
The deposition rate dependence of plasma polymerization on the radius of curvature of the substrate
[DE88-003811] N88-18429
Growth and electronic properties of strained metal overlayers
[DE87-010956] N88-18483

DEPTH
CTD observations in the coastal transition zone off northern California, 16-25 February 1987
[AD-A187283] N88-18111

DEPTH MEASUREMENT
Penetration depth measurements of YBa2Cu3O/sub 7-delta/ at 4 MHz
[DE88-003493] N88-18478

DESIGN ANALYSIS
A transonic-small-disturbance wing design methodology
[NASA-TP-2806] N88-17614
An integrated aero/mechanical performance approach to high technology turbine design N88-17657
Design and test of a high blade speed, high work capacity transonic turbine N88-17658
Design and development of an advanced F100 compressor N88-17678
Design and testing of a front stage for an advanced high pressure compressor N88-17679
The design of trellis codes for fading channels
[NASA-CR-182523] N88-17891
Solid-state voltage standard performance and design guidelines
[PB88-123757] N88-17905
A computational study of thrust augmenting ejectors based on a viscous-inviscid approach N88-17929
Three-dimensional incompressible flowfield analysis for establishing rotor designs which optimize power extraction N88-17943
Optimal design and parameter identification of flexible rotor-bearing systems N88-18002
Design sensitivity analysis of nonlinear structural systems and numerical implementation with established finite element codes N88-18032
Optimum design of geodesically stiffened composite plates
[NASA-CR-182499] N88-18035
Design and implementation of a fiber optic RS232 link
[AD-A187319] N88-18409
A collaborative program of research in engineering sciences
[DE88-003383] N88-18504

DETECTION
Airborne Wind Shear Detection and Warning Systems: First Combined Manufacturers' and Technologists' Conference
[NASA-CP-10006] N88-17616
Windshear detection effect of static air temperature bias N88-17621
Lidar windshear detection and avoidance: Performance and technical assessment N88-17626
The advanced low-level windshear alert system operational demonstration results, Summer, 1987, Denver Stapleton International Airport N88-17633
NMR (Nuclear Magnetic Resonance) imaging for detecting binder/plasticizers in green-state structural ceramics
[DE88-003111] N88-17800
Detection of signals in non-Gaussian correlated noise derived from Cauchy processes
[AD-A187488] N88-17894
Trace analysis by MS/MS on a double focussing mass spectrometer
[AD-A187954] N88-17973
Tactile sensing and inverse problems
[AD-A187464] N88-18011
Piezoelectric laminates for torsional and bending model control: Theory and experiment N88-18029
Rapid underway sediment classification by electrical methods
[AD-A187447] N88-18113

Rapid underway sediment classification by electrical methods
[AD-A187477] N88-18114

DETERIORATION
Corrosion and deterioration testing in humid tropic environments
[AD-A186917] N88-17783

DETONATION WAVES
Flame propagation in the approximation of straight-line trajectories of burning products
[DE88-700675] N88-17756
Diffusion description of flame propagation due to the translational motion of burning reaction products
[DE88-700676] N88-17757

DEUTERIUM COMPOUNDS
Energy transfer studies with lasers
[DE88-004864] N88-17991

DEVIATION
Nonlinear filtering and large deviations: A PDE-Control theoretic approach
[AD-A187436] N88-18321
Asymptotic expansions for large deviation probabilities in the strong law of large numbers
[AD-A187432] N88-18361

DIAGRAMS
CUEMAP: A tool for generating hierarchical charts and dataflow diagrams
[DE88-004778] N88-18284

DIELECTRICS
Guided-wave approaches to spectrally selective energy absorption
[NASA-CR-182532] N88-17892

DIESEL ENGINES
Effect of translucence of engineering ceramics on heat transfer in diesel engines
[DE88-003732] N88-17804
Experimental study of thermal loading at the wall of an industrial Diesel motor
[ISAL-IDI-187-10] N88-18000

DIFFERENTIAL EQUATIONS
Parallels between control PDE's (Partial Differential Equations) and systems of ODE's (Ordinary Differential Equations)
[NASA-CR-182487] N88-18331
Straightening and the Stanley decomposition for the (2;n)-nilpotent vectorfield
[PB88-126685] N88-18336
Boundary value problems for differential and functional differential equations
[AD-A187378] N88-18349
Generalized equations for emittance and field energy of high-current beams in periodic focusing
[DE88-004448] N88-18372
Performance and optimization of direct implicit time integration schemes for use in electrostatic particle simulation codes
[DE88-003254] N88-18381

DIFFERENTIATION (BIOLOGY)
Embryonic development of guppy in weightlessness N88-18127

DIFFRACTION PATTERNS
The magic of carrier patterns in moire interferometry
[AD-A187582] N88-17748

DIFFUSERS
Numerical simulation of axisymmetric turbulent flow in combustors and diffusors
[NASA-CR-4115] N88-17582
The advantage of variable geometry for turbine engines at low power N88-17653
Numerical simulation of diffuser/combustor dome interaction N88-17663

DIFFUSION
Ytterbium monolayer diffusion barriers at Hg(1-x)Cd(x)Te/Al junctions
[AD-A188013] N88-17768
Diffusion studies in amorphous NiZr alloys
[DE88-003009] N88-17781
A multigrid preconditioner applied to a two-dimensional convection-diffusion problem
[DE88-004765] N88-18329
High temperature processing of superconducting Y1Ba2Cu3O6.9
[DE88-003002] N88-18449
Improved magnetization for YBa2Cu3O/sub 7-delta annealed in oxygen above 1000 C
[DE88-003934] N88-18469

DIFFUSION COEFFICIENT
A finite element analysis of adhesively bonded composite joints including geometric nonlinearity, nonlinear viscoelasticity moisture diffusion and delayed failure
[AD-A187455] N88-17747

DIFFUSION ELECTRODES
Advanced materials for solid oxide fuel cells
[DE88-002338] N88-18071

DIFFUSION FLAMES
Diffusion description of flame propagation due to the translational motion of burning reaction products
[DE88-700676] N88-17757

DIGITAL DATA
Information transfer in the National Airspace System N88-17634

DIGITAL SIMULATION
Coronal heating by means of helical magnetohydrodynamic turbulence
[AD-A187084] N88-18413

DIGITAL SYSTEMS
Transport delay compensation for computer-generated imagery systems
[NASA-TM-100084] N88-17845
Formal multilevel hierarchical verification of synchronous MOS VLSI circuits
[AD-A187532] N88-17918
Orthogonal patterns in binary neural networks
[NASA-TM-100060] N88-18320
Subpicosecond optical digital computation using phase conjugate parametric generators
[AD-A188279] N88-18411

DIGITAL TECHNIQUES
Digital imaging techniques for single- and multi-phase reacting flowfields N88-17933

DIMENSIONAL STABILITY
Cost 501 Project UK10 part 3: Thermal fatigue damage of Fecralloy steel-sprayed and co-extruded tubing
[AERE-R-12230] N88-18026

DIMENSIONS
Zero-dimensional model of a reversed field pinch fusion reactor
[DE88-005213] N88-18442

DIMERS
Energy-related atomic and molecular structure and scattering studies
[DE88-004246] N88-18386
Chemical activation of molecules by metals: Experimental studies of electron distributions and bonding
[DE88-004465] N88-18393

DIODES
Evaluation of a temperature remote sensing technique
[AD-A187885] N88-18053

DIPPING
The effect on initial bond strength and durability of a Phosphoric Acid Dip (PAD) following chromic acid anodising of aluminum
[ARE-TM(UMM)-87402] N88-17772

DIRECT CURRENT
Rapid underway sediment classification by electrical methods
[AD-A187447] N88-18113
Rapid underway sediment classification by electrical methods
[AD-A187477] N88-18114

DIRECTIONAL ANTENNAS
Investigation of design considerations for Telemetry, Tracking and Command (TT and C) antenna system on Naval Postgraduate School Orion mini-satellite
[AD-A187130] N88-17718

DIRECTIONAL SOLIDIFICATION (CRYSTALS)
Influence of convection on microstructure
[NASA-CR-182489] N88-17784

DIRECTORIES
Director of R and D institutions (Government of India)
[PB88-127162] N88-17685

DISCONTINUITY
Modeling of some coplanar waveguide discontinuities
[NASA-TM-100808] N88-17880
The relation of solar wind structure to hydromagnetic discontinuities
[DE88-004304] N88-18546

DISCRETE FUNCTIONS
Tactile sensing and inverse problems
[AD-A187464] N88-18011

DISCRIMINATORS
A two-stage isolated-word recognition system using discriminant analysis
[AD-A187425] N88-18360

DISEASES
Forecasting complications of cardiovascular disease in flight personnel N88-18136

DISPENSERS
Aerodynamic aspects of the configurational systems layout of a dispenser
[MBB-UA-1047/87] N88-17863

DISPLAY DEVICES
The advanced low-level windshear alert system operational demonstration results, Summer, 1987, Denver Stapleton International Airport N88-17633
Information transfer in the National Airspace System N88-17634
Helicopter external vision requirements and visual display characteristics: A report/bibliography, revision A
[AD-A187075] N88-17641
Electrochromic cells with lutetium diphthalocyanine and semisolid polymer electrolytes
[AD-A188031] N88-18078

DISTRIBUTED PARAMETER SYSTEMS
A unified framework for approximation in inverse problems for distributed parameter systems
[NASA-CR-181621] N88-18346

DISTRIBUTED PROCESSING
Clouds: A support architecture for fault tolerant, distributed systems N88-18206
A distributed system architecture based on macro dataflow model N88-18210
A comparative study of heurstic algorithms for task assignment in distributed computing systems N88-18211
Distributed control of large parallel computers N88-18215
The design of load balancing strategies for distributed systems N88-18216
Experiments with parallel program execution on a network of workstations N88-18217
Distributed query processing: Present status and future direction N88-18219
Concurrency control and reliability in replicated database systems N88-18221
An anlysis of the reliability of tree-structured interconnection networks N88-18228
On the number of task assignments in distributed computing systems N88-18230
Reuse: A Reliable Unified Service Environment for distributed systems N88-18231
Resilient procedures: A structured replication approach N88-18245
Features of a TeraFlop supercomputer
[DE88-003540] N88-18263

DISTRIBUTION (PROPERTY)
An analytic model for ionization distributions produced in nanometer sites by protons
[DE88-003943] N88-18385

DOCUMENTATION
A hypertext writing environment and its cognitive basis
[AD-A188179] N88-18298

DOGS
Combined effect of ionizing radiation and altered gas atmosphere on central nervous system N88-18188

DOMAINS
Time domain wave propagation in multilayered integrated circuits
[AD-A187462] N88-17918
Fast Poisson solver on irregular regions by boundary integral-based domain decomposition methods
[DE88-003583] N88-18340
Domain decomposition preconditioners for the spectral collocation method
[NASA-CR-181620] N88-18345

DOPPLER EFFECT
Product kinetic and internal energy distributions via velocity-aligned Doppler spectroscopy
[DE88-003510] N88-17764

DOPPLER RADAR
Airborne Wind Shear Detection and Warning Systems: First Combined Manufacturers' and Technologists' Conference
[NASA-CP-10006] N88-17616
Airborne Doppler radar technology for wind shear detection N88-17622
Crew interface with windshear systems N88-17631
Status of FAA terminal Doppler weather radar programs N88-17632
The advanced low-level windshear alert system operational demonstration results, Summer, 1987, Denver Stapleton International Airport N88-17633
MTI-Interface (Moving Target Indication-Interface) for simple radar
[PB88-126578] N88-17884

DOSIMETERS
An analytic model for ionization distributions produced in nanometer sites by protons
[DE88-003943] N88-18385

DOWNLINKING
MARCE data evaluation N88-17693

DOWNWASH
Reduction of tilt rotor download using circulation control N88-17605

DRILLING
Geological evolution and analysis of confirmed or suspected gas hydrate localities. Volume 9: Formation and stability of gas hydrates of the Middle America Trench
[DE88-001007] N88-18050

DROP SIZE
Digital imaging techniques for single- and multi-phase reacting flowfields N88-17933

DROPS (LIQUIDS)
Investigation of real-time two-dimensional visualization of fuel spray liquid/vapor distribution via exciplex fluorescence
[AD-A188268] N88-17816
Transient cooling of a hot surface by droplets evaporation, March 1986 - March 1987
[PB88-153341] N88-17950
Droplet formation for liquid monopropellant jets
[AD-A187172] N88-17956
Turbulence interactions in single- and multi-phase turbulent mixing and combustion processes
[AD-A187505] N88-17960
DROSOPHILA
Drosophila geotaxis as a tool for the study of aging N88-17706
DUCTED FANS
Aerodynamic performance of a scale-model, counter-rotating unducted fan N88-17666
DUCTILITY
The influence of small defects on tensile specimen ductility and symmetry of deformation
[AD-A187983] N88-18044
Brittle to ductile transition to cleavage fracture
[DE88-004074] N88-18481
DUCTS
An estimate of the noise shielding on the fuselage resulting from installing a short duct around an advanced propeller
[NASA-TM-100262] N88-18379
DURABILITY
The effect on initial bond strength and durability of a Phosphoric Acid Dip (PAD) following chromic acid anodising of aluminum
[ARE-TM(UMM)-87402] N88-17772
DUST
Operation of gas turbine engines in dust-laden environments N88-17654
DYE LASERS
Product kinetic and internal energy distributions via velocity-aligned Doppler spectroscopy
[DE88-003510] N88-17764
Modern pulsed wavemeters
[DE88-003875] N88-17978
Nonlinear optics with broad-band lasers
[DE88-005026] N88-17992
Instabilities and chaos in a multimode, standing-wave, CW dye laser
[DE88-005028] N88-17993
DYNAMIC CHARACTERISTICS
Mechanisms of wear in single- and two-phase materials
[DE88-003846] N88-17806
The dynamics of two coupled rigid bodies
[AD-A187592] N88-18012
The dynamics of coupled planar rigid bodies. Part 1: Reduction, equilibria and stability
[AD-A187467] N88-18042
Collaborative studies of polar cap ionospheric dynamics
[AD-A187888] N88-18098
Energy transfers for multilayer hydrodynamic ocean models: General formulation and specific examples
[AD-A187604] N88-18116
Dynamic observers as asymptotic limits of recursive filters: Special cases
[AD-A187578] N88-18324
Growth and electronic properties of strained metal overlayers
[DE87-010956] N88-18463
DYNAMIC CONTROL
Viscosity methods in optimal control of distributed systems
[AD-A188066] N88-18357
DYNAMIC LOADS
The use of multigrid techniques in the solution of the Elrod algorithm for a dynamically loaded journal bearing
[NASA-CR-180873] N88-17954
Preliminary results from the dynamic response testing of the Westinghouse 600-kW wind turbine
[DE88-001123] N88-18070
Analysis of wind turbines on offshore support structures excited by random wind and random waves
[DE88-004772] N88-18074
DYNAMIC MODELS
Strength and structure of Ga sub 1-xIn sub xAs alloys
[AD-A188092] N88-17795
Microwave semiconductor research-materials, devices and circuits
[AD-A187121] N88-18444
DYNAMIC RESPONSE
Monitoring interfacial dynamics by pulsed laser techniques
[DE88-003362] N88-17976
Dynamic response of some structural elements fabricated from a non-linear elastic material N88-18031
Qualification of frequency response functions using the rigid-body response
[DE88-000745] N88-18033
Frequency response function estimation at level
[DE88-002644] N88-18034
Vibration and flutter characteristics of the SR7L large-scale propfan
[NASA-TM-100272] N88-18036
On the dynamic estimation of relative weights for observation and forecast in numerical weather prediction
[NASA-CR-182531] N88-18106
DYNAMIC STRUCTURAL ANALYSIS
Dynamic response of some structural elements fabricated from a non-linear elastic material N88-18031
Frequency response function estimation at level
[DE88-002644] N88-18034
A component synthesis method using Lanczos vectors
[DE88-002263] N88-18368
DYNAMIC TESTS
Comprehensive analysis of helicopters with bearingless rotors
[NASA-CR-182537] N88-18300
DYNAMICAL SYSTEMS
An analysis of the motion and effects of hairpin vortices
[AD-A187261] N88-17958
DYNAMICS
Recursive forward dynamics for multiple robot arms moving a common task object
[NASA-CR-182526] N88-18008

E

EARTH (PLANET)
Planet X probe: A fresh new look at an old familiar place N88-17699
EARTH ATMOSPHERE
Parameterization of radiative transfer in the Earth's atmosphere with specific applications to clouds N88-18087
Theoretical and observational problems with Holes in the far UV dayglow
[AD-A188190] N88-18100
EARTH CRUST
Numerical studies of propagation of Lg waves across ocean continent boundaries using the Representation Theorem (RT) N88-18085
Analysis of gases in the earth's crust
[PB88-141619] N88-18093
EARTH IONOSPHERE
Collaborative studies of polar cap ionospheric dynamics
[AD-A187888] N88-18098
EARTH MAGNETOSPHERE
Simulation and modeling of whistler mode wave growth through cyclotron resonance with energetic electrons in the magnetosphere N88-18089
A study of the magnetic field annihilation process in the magnetosphere and some geotechnical applications
[DE88-004165] N88-18096
EARTH OBSERVATIONS (FROM SPACE)
Planet X probe: A fresh new look at an old familiar place N88-17699
Space-based remote sensing of the Earth: A report to the Congress
[NASA-TM-89709] N88-18046
EARTH RESOURCES PROGRAM
Earth resources: A continuing bibliography with indexes (supplement 56)
[NASA-SP-7041(56)] N88-18051
ECONOMIC ANALYSIS
Exponential lower bounds for finding Brouwer fixed points
[DE88-002864] N88-18513
ECONOMIC DEVELOPMENT
Messerschmitt-Boelkow-Blohm: A company with a tradition N88-17866
ECONOMIC IMPACT
Understanding and accepting fusion as an alternative energy source
[DE88-004356] N88-18432
EDDY VISCOSITY
Evaluation of a research circulation control airfoil using Navier-Stokes methods N88-17591
EDITING
Personal computers and All-In-1: Document transfer and translation
[DE88-003760] N88-18264
EDITING ROUTINES (COMPUTERS)
A hypertext writing environment and its cognitive basis
[AD-A188179] N88-18298
EDUCATION
Training guidelines in non-destructive testing techniques
[DE88-700613] N88-18019
Interdisciplinary research in mathematics, science and technology education
[PB88-131446] N88-18333
EIGENVALUES
On an overdetermined Neumann problem
[AD-A187451] N88-18352
Eigenvalue problems
[AD-A188069] N88-18356
EIGENVECTORS
An application of eigenspace methods to symmetric flutter suppression
[NASA-CR-181618] N88-17684
Eigenvalue problems
[AD-A188069] N88-18356
A component synthesis method using Lanczos vectors
[DE88-002263] N88-18368
EJECTORS
A computational study of thrust augmenting ejectors based on a viscous-inviscid approach N88-17929
ELASTIC DEFORMATION
A large strain thermomechanical forming model for elastic-viscoplastic behavior in metals N88-17780
Institute for Materials Science and Engineering, Fracture and Deformation Division: Technical activities, 1987
[PB88-153622] N88-18039
ELASTIC PLATES
Boundary stabilization of thin elastic plates
[AD-A187123] N88-18025
ELASTIC PROPERTIES
Ultrasonic characterization of layered composite systems N88-18374
ELASTOMERS
Thermoplastic elastomers as LOVA binders
[AD-A186563] N88-17797
ELECTRIC BATTERIES
Laboratory evaluation and analysis of advanced lead-acid load-leveling batteries
[DE88-002851] N88-18064
Fuel cell/battery hybrid vehicle assessment
[DE88-005087] N88-18520
ELECTRIC BRIDGES
Comparative evaluation of resistive and inductive techniques for measuring temperature of superconducting transition
[DE88-700603] N88-18457
ELECTRIC CONNECTORS
Measurement of shielding effectiveness of different cable and shielding configurations by mode-stirred techniques
[PB88-155791] N88-17885
ELECTRIC CORONA
Personal overview of solar wind 6
[DE88-003147] N88-18543
ELECTRIC FIELD STRENGTH
Magnetic control of low pressure discharges
[AD-A186794] N88-17900
ELECTRIC FIELDS
Effect of external electrostatic field on catecholamine secretion by rat adrenals N88-18166
Light absorption by an atom moving inside a spherical box
[AD-A187241] N88-18395
ELECTRIC GENERATORS
Laser production and heating of plasma for MHD application
[NASA-TP-2798] N88-18443
ELECTRIC MOTOR VEHICLES
Fuel cell/battery hybrid vehicle assessment
[DE88-005087] N88-18520
ELECTRIC POWER PLANTS
The role of repowering in America's power generation future
[DOE/FE-0096] N88-18076
ELECTRIC POWER SUPPLIES
Project Explorer takes its second step: GAS-608 in engineering development N88-17707
ELECTRICAL ENGINEERING
Helsinki University of Technology Communications Laboratory
[PB88-112974] N88-17881
ELECTRICAL IMPEDANCE
Application of ac-impedance method on determination of corrosion rate of metals
[DE88-750307] N88-17771
Operators manual for a computer controlled impedance measurement system
[AD-A187513] N88-17917
ELECTRICAL INSULATION
Measurement of shielding effectiveness of different cable and shielding configurations by mode-stirred techniques
[PB88-155791] N88-17885
ELECTRICAL PROPERTIES
Rapid underway sediment classification by electrical methods
[AD-A187447] N88-18113

Rapid underway sediment classification by electrical methods
[AD-A187477] N88-18114

ELECTRICAL RESISTANCE
Comparative evaluation of resistive and inductive techniques for measuring temperature of superconducting transition
[DE88-700603] N88-18457

ELECTRICAL RESISTIVITY
Electrically conducting polymer-copper sulphide composite films, preparation by treatment of polymer-copper (2) acetate composites with hydrogen sulfide
[NASA-TT-20204] N88-17803
Design of a charge sensitive preamplifier on high resistivity silicon
[DE88-003491] N88-17907
Rapid underway sediment classification by electrical methods
[AD-A187447] N88-18113
Rapid underway sediment classification by electrical methods
[AD-A187477] N88-18114
Realistic conductivity geometry model of the human head for interpretation of neuromagnetic data
[PB88-112230] N88-18179
The physics of metallic superlattices: An experimental point of view
[DE88-003080] N88-18452

ELECTRO-OPTICS
Optically controlled devices and ultrafast laser sources for signal processing
[AD-A187417] N88-17995
Multidimensional system analysis of electro-optic sensors with sampled deterministic output
[AD-A187063] N88-18399

ELECTROCARDIOGRAPHY
Results of long-term electrocardiographic monitoring of cosmonauts N88-18152

ELECTROCHEMISTRY
Electrochemical growth of linear conducting crystals in microgravity N88-17698
Studies in finite time thermodynamics
[DE88-004531] N88-18500

ELECTRODEPOSITION
Materials processing in space: An introduction to the G-480 payload N88-17695
Ion chromatography in the manufacture of multilayer circuit boards
[DE88-002428] N88-17902
Investigation of materials for inert electrodes in aluminum electrodeposition cells
[DE88-003360] N88-17906

ELECTRODES
Materials development for JPL oxygen plant
[DE88-003067] N88-17752
Magnetic control of low pressure discharges
[AD-A186794] N88-17900
Investigation of materials for inert electrodes in aluminum electrodeposition cells
[DE88-003380] N88-17906
Determination of optimum electrolyte composition for molten carbonate fuel cells literature review
[DE88-001015] N88-18058

ELECTRODYNAMICS
Comparative evaluation of resistive and inductive techniques for measuring temperature of superconducting transition
[DE88-700603] N88-18457

ELECTROENCEPHALOGRAPHY
Realistic conductivity geometry model of the human head for interpretation of neuromagnetic data
[PB88-112230] N88-18179

ELECTROLYTES
Materials development for JPL oxygen plant
[DE88-003067] N88-17752
Models for ionic transport in glass
[DE88-002660] N88-17799
Electrochromic cells with lutetium diphthalocyanine and semisolid polymer electrolytes
[AD-A186031] N88-18078

ELECTROLYTIC CELLS
Investigation of materials for inert electrodes in aluminum electrodeposition cells
[DE88-003380] N88-17906
Determination of optimum electrolyte composition for molten carbonate fuel cells literature review
[DE88-001015] N88-18058

ELECTROMAGNETIC FIELDS
Time-domain reciprocity theorems for electromagnetic fields in dispersive media
[PB88-126925] N88-17886
Forces on neutral atoms due to electromagnetic fields
[AD-A187461] N88-18396
The stability of free-electron lasers against filamentation
[DE88-004712] N88-18435

ELECTROMAGNETIC INTERFERENCE
Measurement of shielding effectiveness of different cable and shielding configurations by mode-stirred techniques
[PB88-155791] N88-17885
Satellite interference analysis and simulation using personal computers
[NASA-CR-182522] N88-17890

ELECTROMAGNETIC RADIATION
Direct scattering of electromagnetic waves by one- and two-dimensional objects and its use for inverse profiling
[PB88-126909] N88-17887
Velocity reversal and the arrows of time
[DE88-004237] N88-18536

ELECTROMAGNETIC SCATTERING
Calculation of the spatial-temporal deformation of laser pulses in multiple scattering
[MBB-Z-111/87] N88-17837
Direct scattering of electromagnetic waves by one- and two-dimensional objects and its use for inverse profiling
[PB88-126909] N88-17887
Three-dimensional transient electromagnetic modeling for exploration geophysics N88-18047

ELECTROMAGNETIC SHIELDING
Measurement of shielding effectiveness of different cable and shielding configurations by mode-stirred techniques
[PB88-155791] N88-17885

ELECTRON ACCELERATORS
A ring model of the lasertron
[DE88-004656] N88-17908

ELECTRON BEAMS
A ring model of the lasertron
[DE88-004656] N88-17908
Preliminary injector, accelerator, and beamline design for rf-linac-driven XUV free-electron lasers
[DE88-003185] N88-17983
Betatron oscillations in a free electron laser
[DE88-004859] N88-17990
Tapered wiggler analysis of high gain free electron laser oscillators
[AD-A187997] N88-17997
The stability of free-electron lasers against filamentation
[DE88-004712] N88-18435
Effects of X irradiation and high field electron injection on the electrical properties of rapid thermal oxides
[DE88-002642] N88-18461

ELECTRON CAPTURE
Application of ECR ion source beams in atomic physics
[DE88-003767] N88-18384

ELECTRON CYCLOTRON HEATING
New mode conversion process and overdense plasma heating in the electron cyclotron range of frequencies
[IPPJ-854] N88-18420
First and second harmonic ECRH experience at gyrotron frequencies at LLNL
[DE88-003998] N88-18430

ELECTRON DENSITY (CONCENTRATION)
Chemical activation of molecules by metals: Experimental studies of electron distributions and bonding
[DE88-004465] N88-18393
Specific heat of novel thin-film material systems N88-18446
Positron-annihilation 2D-ACAR studies of disordered and defected alloys
[DE88-003118] N88-18454
Penetration depth measurements of YBa2Cu3O/sub 7-delta/ at 4 MHz
[DE88-003493] N88-18478

ELECTRON DIFFRACTION
Solving complex and disordered surface structures with electron diffraction
[DE88-003863] N88-18467

ELECTRON ENERGY
Magnetic control of low pressure discharges
[AD-A186794] N88-17900
Kinetic studies following state-selective laser excitation
[DE88-004094] N88-17981

ELECTRON GAS
Self-similar solutions of MHD equations of plasma filament in the case of complete degenerated ultrarelativistic electron gas
[DE88-700684] N88-18426

ELECTRON MICROSCOPES
The measurement of chemical compositon with high spatial resolution using a dedicated scanning transmission electron microscope
[AERE-R-12317] N88-17753

ELECTRON MICROSCOPY
High resolution electron and ion microscopy
[AERE-R-12502] N88-17754
Transmission electron microscopy studies of titanium-containing braze/alumina seals
[DE88-005243] N88-17792
Application of nondestructive testing techniques to materials testing
[AD-A187645] N88-18021
Simulation and processing of high resolution images of defects and interfaces in superconducting YBa2Cu3O7
[DE88-003856] N88-18480

ELECTRON OSCILLATIONS
Tapered wiggler analysis of high gain free electron laser oscillators
[AD-A187997] N88-17997

ELECTRON PLASMA
Self-similar solutions of MHD equations of plasma filament in the case of complete degenerated ultrarelativistic electron gas
[DE88-700684] N88-18426

ELECTRON SCATTERING
Correlated processes in atomic collisions
[DE88-003508] N88-18383

ELECTRON SOURCES
The measurement of chemical compositon with high spatial resolution using a dedicated scanning transmission electron microscope
[AERE-R-12317] N88-17753

ELECTRON TRANSFER
Insights into the mechanisms of chemical reactions: Reaction paths for chemical reactions
[DE88-003041] N88-17755
Energy transfer and photochemistry in biomimetic solar conversion
[PB88-130026] N88-18057
Correlated processes in atomic collisions
[DE88-003508] N88-18383
Electron transfer to iron(3) oxide colloids
[DE88-002885] N88-18448

ELECTRON TRANSITIONS
Theoretical studies of atomic transitions
[DE88-004719] N88-18389

ELECTRONIC CONTROL
Pumping systems and flow interfaces for rapid response electronic reheat controls N88-17885

ELECTRONIC EQUIPMENT
Joint services electronics program
[AD-A187587] N88-17920
MBE growth, characterization and electronic device processing of HgCdTe, HgZnTe related heterojunctions and HgCdTe-CdTe superlattices
[AD-A187456] N88-18486

ELECTRONS
Dynamics of coupled electron-nucleon motion in a laser field
[DE88-005063] N88-17994
Suppression of X-rays generated by runaway electrons in ATF
[DE88-004179] N88-18440
Electron transfer to iron(3) oxide colloids
[DE88-002885] N88-18448
The electronic structure of YBa2Cu3O/sub 7-delta/ above and below T/sub c/
[DE88-003495] N88-18479

ELECTROPHORESIS
GAS 450: A space payload for the People Central Coast Student Experimenters N88-17709
Optimization of the southern electrophoretic transfer method
[DE88-004527] N88-17765

ELECTROSTATIC PROBES
Asymmetric double Langmuir probe for fast and automatic measurements of plasma temperature
[DE88-004773] N88-18436

ELECTROTHERMAL ENGINES
Characterization of the arc/spark excitation sources used in the spectrometric oil analysis program
[AD-A187131] N88-17758

ELIMINATION
Eliminating columns in the simplex method for linear programming
[DE88-004191] N88-18277

ELLIPTIC DIFFERENTIAL EQUATIONS
Recent progress in the p and h-p version on the finite element method
[AD-A187254] N88-18347
The h-p version of the finite element method for problems with nonhomogeneous essential boundary condition
[AD-A187356] N88-18348

ELLIPTICITY
Wind tunnel studies of circulation control elliptical airfoils N88-17598

EMBEDDED COMPUTER SYSTEMS
Factors causing unexpected variations in Ada benchmarks
[AD-A187231] N88-18291
EMBRITTLEMENT
Effect of low-temperature aging on the mechanical properties of cast stainless steels
[DE88-002872] N88-17774
EMBRYOLOGY
Embryonic development of guppy in weightlessness N88-18127
EMISSION SPECTRA
The development of emission tomography for the nuclear industry
[AERE-R-12319] N88-18014
EMITTANCE
Emittance studies at the Los Alamos National Laboratory Free-Electron Laser (FEL)
[DE88-003146] N88-17975
Generalized equations for emittance and field energy of high-current beams in periodic focusing
[DE88-004448] N88-18372
ENDOTHELIUM
Interactions of cultured human endothelial cells with polymeric surfaces
[PB88-112255] N88-18178
ENERGETIC PARTICLES
Research in experimental nuclear physics
[DE88-004100] N88-18397
ENERGY ABSORPTION
Guided-wave approaches to spectrally selective energy absorption
[NASA-CR-182532] N88-17892
ENERGY CONVERSION
Advanced energy conversion concept for beamed-energy propulsion
[AD-A187336] N88-17914
ENERGY CONVERSION EFFICIENCY
A ring model of the lasertron
[DE88-004656] N88-17908
Laser production and heating of plasma for MHD application
[NASA-TP-2798] N88-18443
ENERGY DISSIPATION
Stellar energy loss and anomalous contributions to the (photon photon) (neutrino antineutrino) interaction
[DE88-700618] N88-18529
ENERGY DISTRIBUTION
Product kinetic and internal energy distributions via velocity-aligned Doppler spectroscopy
[DE88-003510] N88-17764
ENERGY LEVELS
Frequency response function estimation at level
[DE88-002644] N88-18034
ENERGY POLICY
The role of repowering in America's power generation future
[DOE/FE-0096] N88-18076
Understanding and accepting fusion as an alternative energy source
[DE88-004356] N88-18432
ENERGY TECHNOLOGY
Side-by-side comparisons of evacuated compound parabolic concentrator and flat plate solar collector systems at temperatures of 90 to 100°C
[DE88-004717] N88-18073
Understanding and accepting fusion as an alternative energy source
[DE88-004356] N88-18432
Minutes of the meeting of the Indo-US Subcommission on Science and Technology (8th) held at Washington, D.C. on September 22-24, 1986
[PB88-130158] N88-18503
ENERGY TRANSFER
A dynamical system/coherent structure approach to the fully developed turbulent wall layer N88-17578
Kinetic studies following state-selective laser excitation
[DE88-004094] N88-17981
Energy transfer studies with lasers
[DE88-004864] N88-17991
Research on fluid dynamic energy separation
[DE88-002776] N88-18001
Energy transfer and photochemistry in biomimetic solar conversion
[PB88-130026] N88-18057
Energy transfers for multilayer hydrodynamic ocean models: General formulation and specific examples
[AD-A187604] N88-18116
Spectroscopic studies of energy transfer in photosynthetic reaction centers of higher plants
[DE88-003850] N88-18121
State-to-state dynamics of molecular energy transfer
[DE88-003262] N88-18382
Coronal heating by means of helical magnetohydrodynamic turbulence
[AD-A187084] N88-18413
ENGINE CONTROL
Pumping systems and flow interfaces for rapid response electronic reheat controls N88-17665
Possibilities for on-line surge suppression by fast guide vane adjustment in axial compressors N88-17674
ENGINE DESIGN
Advanced Technology for Aero Gas Turbine Components
[AGARD-CP-421] N88-17647
The coming revolution in turbine engine technology N88-17648
An examination of the impact of potential advances in component technology for future military engines N88-17650
Specification of an engine and its components starting from a consideration of aircraft missions N88-17651
Experimental evaluation of a translating nozzle sidewall radial turbine N88-17656
An integrated aero/mechanical performance approach to high technology turbine design N88-17657
Design and testing of a small radial turbine for auxiliary power units N88-17661
Design and aerodynamic performance of a small mixed-flow gas generator turbine N88-17662
Development of a plenum chamber burner system for an advanced VTOL engine N88-17664
Analysis of possible transmission arrangements applicable for driving single or twin counterrotating fans on propfan engines N88-17670
ENGINE PARTS
An examination of the impact of potential advances in component technology for future military engines N88-17650
Specification of an engine and its components starting from a consideration of aircraft missions N88-17651
Free-piston Stirling engine diaphragm-coupled heat-actuated heat pump component technology program, phase 1C
[DE88-003654] N88-17949
Ceramic bearings for use in gas turbine engines
[NASA-TM-100288] N88-18007
An evaluation of effectiveness of PTFE (polytetrafluoroethylene) type friction reducers on reducing friction and wear
[AD-A187440] N88-18010
ENGINE TESTS
Design and testing of a small radial turbine for auxiliary power units N88-17661
Design and development of an advanced F100 compressor N88-17678
ENGINEERING DRAWINGS
Free-piston Stirling engine diaphragm-coupled heat-actuated heat pump component technology program, phase 1C
[DE88-003654] N88-17949
ENGINEERING MANAGEMENT
Non-proprietary research projects of the Center for the Space Processing of Engineering Materials
[AR-2] N88-18516
ENTROPY
Studies in finite time thermodynamics
[DE88-004531] N88-18500
ENVIRONMENT EFFECTS
Cape Blanco wind farm feasibility study
[DE88-003748] N88-18059
Cape Blanco wind farm feasibility study
[DE88-003749] N88-18060
ENVIRONMENT MODELS
Evaluation of regional-scale air quality models: Chairmen reports from four workshops
[DE88-001397] N88-18080
ENVIRONMENT POLLUTION
Environmental projects. Volume 4: Asbestos survey
[NASA-CR-182527] N88-18083
ENVIRONMENTAL CHEMISTRY
Environment assisted degradation mechanisms in aluminum-lithium alloys
[NASA-CR-182482] N88-17782
ENVIRONMENTAL MONITORING
Meteorological and aerosol measurements from the NOAA WP-3D aircraft during WATOX-86, January 4-9, 1986
[PB88-120860] N88-18079
Environmental projects. Volume 4: Asbestos survey
[NASA-CR-182527] N88-18083
ENVIRONMENTS
A hypertext writing environment and its cognitive basis
[AD-A188179] N88-18298
ENZYME ACTIVITY
Myosin Ca sup (2+), Mg sup (2+)-adenosine triphosphatase activity in ray myocardium following 30-day expose to 1.1 and 2.0 G N88-18141
Oxidative enzyme activity in healthy subjects and individuals with neurocirculatory dystonia during graded exercise N88-18170
ENZYMES
Spectroscopic studies of energy transfer in photosynthetic reaction centers of higher plants
[DE88-003850] N88-18121
EPITAXY
Formation of optical waveguides by ion implantation
[DE88-003894] N88-18407
EPOXY MATRIX COMPOSITES
Effect of post-cure heat-treatment on static and fatigue behaviour of XAS-914C carbon fibre composite
[AD-A186943] N88-17735
Effect of thermal shock on carbon fiber/epoxy composites
[PB88-128228] N88-17741
EPOXY RESINS
Analytical and experimental characterization of damage processes in composite laminates
[AD-A187221] N88-17746
EQUATIONS OF MOTION
Maneuverable reentry vehicle trajectory footprints: Calculation and properties
[DE88-004726] N88-17726
Generalized equations for emittance and field energy of high-current beams in periodic focusing
[DE88-004448] N88-18372
EQUATIONS OF STATE
Zero temperature quark matter equation of state
[DE88-003408] N88-18496
EQUATORIAL REGIONS
An analysis of longitude variations in the equatorial spectrum of Saturn N88-18539
EQUILIBRIUM EQUATIONS
Flap-lag-torsion aeroelastic stability of a circulation control rotor in forward flight N88-17600
The dynamics of coupled planar rigid bodies. Part 1: Reduction, equilibria and stability
[AD-A187467] N88-18042
EQUIPMENT SPECIFICATIONS
Supercritical fluid extraction-gas chromatography of Volatile Organic Compounds (VOC) from tenax devices
[PB88-124300] N88-17759
EQUIVALENT CIRCUITS
On the choice of a element low-noise preamplifier on bipolar transistors
[DE88-700639] N88-17904
EROSION
Operation of gas turbine engines in dust-laden environments N88-17654
Effects of ion implantation on cavitation erosion of a cobalt based metal/carbide alloy
[AD-A187239] N88-17793
Mechanisms of wear in single- and two-phase materials
[DE88-003846] N88-17806
ERROR ANALYSIS
Designing variable-length codes with good error-recovery properties
[BBC-RD-1987/19] N88-17876
ERROR CORRECTING DEVICES
Implementation of encoders and decoders for Reed-Solomon codes
[PB88-126628] N88-18286
ERRORS
Emittance studies at the Los Alamos National Laboratory Free-Electron Laser (FEL)
[DE88-003146] N88-17975
Systematic errors of the FSU global spectral model N88-18103
ESTIMATES
Frequency response function estimation at level
[DE88-002644] N88-18034
On the dynamic estimation of relative weights for observation and forecast in numerical weather prediction
[NASA-CR-182531] N88-18106
Well-posedness and spectral estimation for infinite dimensional systems
[AD-A187621] N88-18354
ESTIMATING
A generalized quantile estimator under censoring
[AD-A188280] N88-18364
ETCHING
The mechanism of anisotropic silicon etching and its relevance for micromachinings
[MBB-UA-1013/86] N88-17838
Apparatus for the study of silicon film deposition and silicon etching
[AD-A187616] N88-17972
ETHANE
Gas hydrate model development and validation
[DE88-001004] N88-17762
EULER EQUATIONS OF MOTION
Radial compressor design using an Euler solver N88-17675

Three-dimensional Euler solutions for hypersonic Mach numbers
[MBB-UR-944/87] N88-17859

EUROPEAN AIRBUS
Airbus, the successful European cooperation
[MBB-UT-005/87] N88-17847

EUROPEAN SPACE AGENCY
Study for history of technology developments in European space projects
[REPT-8518-1] N88-17690

EUROPEAN SPACE PROGRAMS
Study on long term evolution towards European manned space flight. Volume 1: Executive summary
[MBB-RA3-004/87-VOL-1] N88-17689
Study for history of technology developments in European space projects
[REPT-8518-1] N88-17690
AZUR, the first German research satellite 625-A, 1964-1969 N88-17827
Trends in the development of space transportation systems
[MBB-UR-911/86] N88-17857
JPRS report: Science and Technology. Europe and Latin America
[JPRS-ELS-88-002] N88-17870

EUTECTIC COMPOSITES
Influence of convection on microstructure
[NASA-CR-182489] N88-17784

EVALUATION
Corrosion and deterioration testing in humid tropic environments
[AD-A186917] N88-17783
Evaluation of bituminous materials used in pavement recycling projects at Tyndall, MacDill, and Hurlburt Air Force Bases
[AD-A188068] N88-17871
Laboratory evaluation and analysis of advanced lead-acid load-leveling batteries
[DE88-002851] N88-18064
Supercomputer performance: The theory, practice, and results
[DE88-004697] N88-18266
A method for assessing the software engineering capability of contractors: Preliminary version
[AD-A187230] N88-18290

EVAPORATIVE COOLING
Transient cooling of a hot surface by droplets evaporation, March 1986 - March 1987
[PB88-153341] N88-17950

EVOLUTION (DEVELOPMENT)
Morphological manifestations of primate adaptation to orthograde statics and walking erect N88-18162

EXCIMER LASERS
Where directed energy stands in strategic defense
[DE88-005092] N88-18365

EXCITATION
Frequency response function estimation at level
[DE88-002644] N88-18034
Correlated processes in atomic collisions
[DE88-003508] N88-18383
Electronic structure, charge transfer excitations and high temperature superconductivity
[DE88-003096] N88-18453

EXCLUSION
Non-mythical generalization of Dekker's algorithm and its ramifications
[PB88-126321] N88-18285

EXHAUST NOZZLES
Advanced Technology for Aero Gas Turbine Components
[AGARD-CP-421] N88-17647
Experimental evaluation of a translating nozzle sidewall radial turbine N88-17656
A computational study of thrust augmenting ejectors based on a viscous-inviscid approach N88-17929

EXOBIOLOGY
Present stage of space medicine N88-18151
NASA Workshop on Biological Adaptation
[NASA-TM-89468] N88-18174
USSR Space Life Sciences Digest, issue 15
[NASA-CR-3922(18)] N88-18175
Aerospace medicine and biology: A cumulative index to a continuing bibliography (supplement 306)
[NASA-SP-7011(306)] N88-18180
Aerospace medicine and biology: A continuing bibliography with indexes (supplement 308)
[NASA-SP-7011(308)] N88-18183

EXPANSION
Asymptotic expansions for large deviation probabilities in the strong law of large numbers
[AD-A187432] N88-18361

EXPERIMENT DESIGN
The challenge of G-376 N88-17705
The NORSTAR Program: Space shuttle to space station N88-17710
Annotated computer output for split plot design: GENSTAT ANOVA
[AD-A187120] N88-18271

EXPERT SYSTEMS
An expert system to support the verification/validation of flight-critical software
[MBB-UT-102/87] N88-17852
Methods of eliciting information from experts
[AD-A187468] N88-18189
Archetyping: A knowledge-based reuse paradigm N88-18214
Optical symbolic processor for expert system execution
[AD-A187494] N88-18268

EXPLORATION
Analysis of gases in the earth's crust
[PB88-141619] N88-18093

EXPLORER SATELLITES
Into the thermosphere: The atmosphere explorers
[NASA-SP-490] N88-18084

EXPLORER 51 SATELLITE
Into the thermosphere: The atmosphere explorers
[NASA-SP-490] N88-18084

EXPLORER 54 SATELLITE
Into the thermosphere: The atmosphere explorers
[NASA-SP-490] N88-18084

EXPLORER 55 SATELLITE
Into the thermosphere: The atmosphere explorers
[NASA-SP-490] N88-18084

EXPLOSIONS
NF85: A three-dimensional, air-dynamics computer code for analyzing explosions in structures
[DE88-005085] N88-17953
Modeling of the non-auditory response to blast overpressure
[AD-A187397] N88-18184
Supernova mechanisms: Before and after SN1987a
[DE88-003489] N88-18533

EXPLOSIVES
EXPLO: Explosives thermal analysis computer code
[DE88-001938] N88-17814

EXPONENTIAL FUNCTIONS
Exponential lower bounds for finding Brouwer fixed points
[DE88-002864] N88-18513

EXPOSURE
Corrosion and deterioration testing in humid tropic environments
[AD-A186917] N88-17783
Los Alamos optical materials reliability, maintainability, and exposure testing program
[DE88-001953] N88-18404

EXTREME ULTRAVIOLET RADIATION
Preliminary injector, accelerator, and beamline design for rf-linac-driven XUV free-electron lasers
[DE88-003185] N88-17983

EXTREMELY LOW RADIO FREQUENCIES
Ultra-low frequency vibration data acquisition concerns in operating flight simulators
[DE88-004795] N88-17687

EXTRUDING
Cost 501 Project UK10 part 3: Thermal fatigue damage of Fecralloy steel-sprayed and co-extruded tubing
[AERE-R-12230] N88-18026

F

FABRICATION
Fabrication, phase transformation studies and characterization of SiC-AlN-Al2OC ceramics
[DE88-004053] N88-17807
An integrated pressure sensor for in-vivo use N88-17965
On systolic architectures for interpolation and integration N88-18250
Fabrication and evaluation of transmissive multilayer optics for 8 keV X-rays
[DE88-003999] N88-18402
The effect of magnetic impurities and barriers on the magnetization and critical current of fine filament NbTi composites
[DE88-004443] N88-18472

FABRICS
Composite materials for rail transit systems
[NASA-CR-178401] N88-17738

FABRY-PEROT INTERFEROMETERS
Modern pulsed wavemeters
[DE88-003875] N88-17978

FACTORIZATION
Navier-Stokes simulation of wind-tunnel flow using LU-ADI factorization algorithm
[NASA-TM-100042] N88-17584
A multiprocessor scheme for the singular value decomposition
[DE88-003591] N88-18288

FAILURE
A finite element analysis of adhesively bonded composite joints including geometric nonlinearity, nonlinear viscoelasticity moisture diffusion and delayed failure
[AD-A187455] N88-17747
Latent failures and coverage in fault-tolerant systems. A VLSI CMOS circuit design technique to aid test generation
[AD-A187615] N88-17921

FAILURE ANALYSIS
Studies of the initiation of pitting corrosion on stainless steels
[AERE-M-3615] N88-17778
Institute for Materials Science and Engineering, Fracture and Deformation Division: Technical activities, 1987
[PB88-153622] N88-18039
A strategy for failure prediction N88-18243

FALSE ALARMS
Response of wind shear warning systems to turbulence with implication of nuisance alerts N88-17618
Windshear warning aerospatiale approach N88-17620
Airworthiness considerations N88-17636

FAN BLADES
Aerodynamic performance of a scale-model, counter-rotating unducted fan N88-17666

FAR ULTRAVIOLET RADIATION
Theoretical and observational problems with Holes in the far UV dayglow
[AD-A188190] N88-18100

FATIGUE (MATERIALS)
Effect of post-cure heat-treatment on static and fatigue behaviour of XAS-914C carbon fibre composite
[AD-A186943] N88-17735

FATIGUE LIFE
Relationship between fatigue life in the creep-fatigue region and stress-strain response
[NASA-TM-100798] N88-18040

FAULT TOLERANCE
Latent failures and coverage in fault-tolerant systems. A VLSI CMOS circuit design technique to aid test generation
[AD-A187615] N88-17921
Navigation recovery block design description
[NASA-CR-182473] N88-18022
Clouds: A support architecture for fault tolerant, distributed systems N88-18206
Resilient procedures: A structured replication approach N88-18245

FEASIBILITY ANALYSIS
Rendezvous and docking verification and demonstration in orbit, executive summary
[MBB-303-16/86] N88-17719
Cape Blanco wind farm feasibility study
[DE88-003748] N88-18059
Cape Blanco wind farm feasibility study
[DE88-003749] N88-18060
Rapid underway sediment classification by electrical methods
[AD-A187447] N88-18113
Rapid underway sediment classification by electrical methods
[AD-A187477] N88-18114

FEEDBACK
Local bifurcation control
[AD-A187435] N88-17915

FEEDBACK CONTROL
Robust controller design for flexible structures
[AD-A187217] N88-18009
Piezoelectric laminates for torsional and bending model control: Theory and experiment N88-18029
Time delays and boundary feedback stabilization in one-dimensional viscoelasticity, appendices A through H
[AD-A187534] N88-18353

FERROELECTRICITY
Piezoelectric laminates for torsional and bending model control: Theory and experiment N88-18029

FERROMAGNETIC MATERIALS
Spin disorder resistivity and bare Curie temperature in the ferromagnetic superconductor ErRh4B4
[DE88-003016] N88-18445

FERROMAGNETISM
Magnetic rare earth superlattices
[DE88-003483] N88-18465

FIBER COMPOSITES
Effect of post-cure heat-treatment on static and fatigue behaviour of XAS-914C carbon fibre composite
[AD-A186943] N88-17735
Fabrication and materials evaluation of high performance aligned ceramic fibre reinforced glass matrix composite
[AERE-R-12517] N88-17736
A fiber-resin micromechanics analysis of the delamination front in a DCB specimen
[NASA-TM-100540] N88-17737

Effects of aviation fluids on carbon fibre composite material
[PB88-127857] N88-17740
Effect of thermal shock on carbon fiber/epoxy composites
[PB88-128228] N88-17741
Mechanics of composite materials: Past, present and future
[NASA-TM-100793] N88-17744
Finite element substructuring methods for composite mechanics
[NASA-TM-100297] N88-17745
Friction and wear of monolithic and fiber reinforced silicon-ceramics sliding against IN-718 alloy at 25 to 800 C in atmospheric air at ambient pressure
[NASA-TM-100294] N88-17796
Testing of a tail rotor system in a fiber composite type of construction
[MBB-UD-472/86] N88-17854

FIBER OPTICS
Failure-resistant Fibre-Optical Communication Line (FOCL)
[DE88-700470] N88-18400
Design and implementation of a fiber optic RS232 link
[AD-A187319] N88-18409

FIELD EFFECT TRANSISTORS
Design of a charge sensitive preamplifier on high resistivity silicon
[DE88-003491] N88-17907
Study of quantum mechanical effects in deep submicron, grating-gate field effect transistors
[AD-A186283] N88-17923

FIGHTER AIRCRAFT
Calculation of aerodynamic characteristics of airplane configurations at high angles of attack
[NASA-CR-182541] N88-17612
An examination of the impact of potential advances in component technology for future military engines
N88-17650
Research and development. Technical-scientific publications (1956-1987): Retrospective view and prospects. Jubilee edition on the occasion of the 75th birthday of Dipl.-Engr. Dr.-Engr. E. H. Ludwig Boelkow
[ISSN-0931-9751] N88-17819
Future fighter manouverability for air combat
[MBB/LKE-1/S/PUB/120] N88-17843
Flight testing of fighter aircraft
[MBB/LKE-62/S/PUB/292] N88-17844

FILM THICKNESS
Effect of the gate oxide thickness on the speed of MOS integrated circuits
[PB88-155783] N88-17910
Specific heat of novel thin-film material systems
N88-18446

FINGERS
Tactile sensing and inverse problems
[AD-A187464] N88-18011

FINITE DIFFERENCE THEORY
Navier-Stokes computations for circulation control airfoils N88-17592
EXPLO: Explosives thermal analysis computer code
[DE88-001938] N88-17814
A three-dimensional dual potential procedure for rotational flows N88-17942
Application of a multigrid method to a buoyancy-induced flow problem
[DE88-003961] N88-18326

FINITE ELEMENT METHOD
Finite element substructuring methods for composite mechanics
[NASA-TM-100297] N88-17745
A finite element analysis of adhesively bonded composite joints including geometric nonlinearity, nonlinear viscoelasticity moisture diffusion and delayed failure
[AD-A187455] N88-17747
A large strain thermomechanical forming model for elastic-viscoplastic behavior in metals N88-17780
Zonal solutions for viscous flow problems. Finite approximations in fluid mechanics
[MBB/LKE-122/S/PUB/226] N88-17846
Boundary integral analysis of flow and deformation of long bubbles in capillaries
[DE88-002110] N88-17927
Design sensitivity analysis of nonlinear structural systems and numerical implementation with established finite element codes N88-18032
Vibration and flutter characteristics of the SR7L large-scale propfan
[NASA-TM-100272] N88-18036
Benchmark computation and finite element performance evaluation for a rhombic plate bending problem
[AD-A187402] N88-18041
Recent progress in the p and h-p version on the finite element method
[AD-A187254] N88-18347
The h-p version of the finite element method for problems with nonhomogeneous essential boundary condition
[AD-A187356] N88-18348
Eigenvalue problems
[AD-A188069] N88-18356

FINITE VOLUME METHOD
Solution of the three-dimensional Navier-Stokes equations for transonic flow using a multigrid method
N88-17579
Radial compressor design using an Euler solver
N88-17675

FINLAND
Helsinki University of Technology Communications Laboratory
[PB88-112974] N88-17881

FISHES
Embryonic development of guppy in weightlessness
N88-18127

FIXED POINTS (MATHEMATICS)
Exponential lower bounds for finding Brouwer fixed points
[DE88-002864] N88-18513

FIXED WINGS
Analysis of a fixed-pitch X-wing rotor employing lower surface blowing N88-17602
Fixed wing CCW aerodynamics with and without supplementary thrust deflection N88-17607

FLAME PROPAGATION
Flame propagation in the approximation of straight-line trajectories of burning products
[DE88-700675] N88-17756
Diffusion description of flame propagation due to the translational motion of burning reaction products
[DE88-700676] N88-17757

FLASH POINT
Flash threshold of shocked aluminum silicofluoride
[DE88-003978] N88-18005

FLASHING (VAPORIZING)
Mechanistic model for void distribution in flashing flow
[DE88-002948] N88-17928

FLAT PLATES
Interferometric study of natural convection heat transfer from a vertical flat plate with transverse roughness elements N88-17935
Side-by-side comparisons of evacuated compound parabolic concentrator and flat plate solar collector systems at temperatures of 90 to 100°C
[DE88-004717] N88-18073

FLEXIBLE BODIES
Robust controller design for flexible structures
[AD-A187217] N88-18009

FLICKER
Universal power spectra for wave turbulence: Applications to wind waves, flicker noise, solar wind spectrum and classical second sound N88-17879

FLIGHT CONTROL
Light Electronic Control System (LECOS): A proposal for a interconnected error-tolerant, optoelectronic control system
[MBB-UT-004/87] N88-17836
Trends in the distribution of tasks between commercial pilots and flight control systems
[MBB-UT-008/87] N88-17351

FLIGHT CREWS
Ultra-low frequency vibration data acquisition concerns in operating flight simulators
[DE88-004795] N88-17887
Forecasting complications of cardiovascular disease in flight personnel N88-18136

FLIGHT MECHANICS
Special flight mechanical features of the bearingless helicopter rotor
[MBB-FM-315/O] N88-17825

FLIGHT SAFETY
Annual review of aircraft accident data: US air carrier operations calendar year 1985
[PB88-135843] N88-17638
AEV local verification for aviation, precipitation and temperature programs: AV, REL, TEM (September 1987 revision)
[PB88-115662] N88-18101
Medical and psychological problems of assuring flight safety under present conditions N88-18123

FLIGHT SIMULATION
Frequency-response identification of XV-15 tilt-rotor aircraft dynamics N88-17643
Transport delay compensation for computer-generated imagery systems
[NASA-TM-100084] N88-17645

FLIGHT SIMULATORS
Investigation of the influence of wind shear on the aerodynamic characteristics of aircraft using a vortex-lattice method N88-17619
Ultra-low frequency vibration data acquisition concerns in operating flight simulators
[DE88-004795] N88-17887

FLIGHT TESTS
Recommendations for ground effects research for V/STOL and STOL aircraft and associated equipment for large scale testing
[NASA-CR-177429] N88-17585
A potential flight evaluation of an upper-surface-blowing/circulation-control-wing concept
N88-17609
X-29A forward-swept-wing flight research program status
[NASA-TM-100413] N88-17644
Flight testing of fighter aircraft
[MBB/LKE-62/S/PUB/292] N88-17844

FLOW CHARACTERISTICS
Numerical simulation of diffuser/combustor dome interaction N88-17663

FLOW DISTRIBUTION
Investigations of a circulation control airfoil flowfield using an advanced laser velocimeter N88-17589
Evaluation of a research circulation control airfoil using Navier-Stokes methods N88-17591
On the effect of leading edge blowing on circulation control airfoil aerodynamics N88-17595
Pressure distributions and oil-flow patterns for a swept circulation-control wing N88-17596
The impact of circulation control on rotary aircraft controls systems N88-17601
Investigation of dynamic stall using LDV (Laser Doppler Velocimetry): Mean flow studies
[AD-A187629] N88-17611
Numerical methods for propeller aerodynamics and acoustics at DFVLR N88-17668
Investigation of dihedral effects in compressor cascades N88-17672
Parametric study of choke flutter with a linear theory
N88-17673
Secondary flow measurements with L2F-technique in centrifugal compressors N88-17676
Zonal solutions for viscous flow problems. Finite approximations in fluid mechanics
[MBB/LKE-122/S/PUB/226] N88-17846
Mechanistic model for void distribution in flashing flow
[DE88-002948] N88-17928
A computational study of thrust augmenting ejectors based on a viscous-inviscid approach N88-17929
Investigation of non-symmetric jets in cross flow
N88-17932
The numerical and analytical study of bifurcation and multicellular flow instability due to natural convection between narrow horizontal isothermal cylindrical annuli at high Rayleigh numbers N88-17937
Three-dimensional incompressible flowfield analysis for establishing rotor designs which optimize power extraction N88-17943
Experimental research on swept shock wave/boundary layer interactions
[AD-A187250] N88-17957
Flow patterns induced by vortices
[NAL-TR-932] N88-17963
Relaxing the brightness constancy assumption in computing optical flow
[AD-A187437] N88-18410

FLOW MEASUREMENT
Boundary-layer and wake measurements on a swept, circulation-control wing N88-17597
Turbulence interactions in single- and multi-phase turbulent mixing and combustion processes
[AD-A187505] N88-17960

FLOW STABILITY
Control of vortical separation on conical bodies
N88-17580
Possibilities for on-line surge suppression by fast guide vane adjustment in axial compressors N88-17674
Instability and transition in curved channel flow
N88-17938
Droplet formation for liquid monopropellant jets
[AD-A187172] N88-17956

FLOW VELOCITY
Parametric study of choke flutter with a linear theory
N88-17673
Possibilities for on-line surge suppression by fast guide vane adjustment in axial compressors N88-17674
Development and application of oxygen flow tagging for velocity measurements and flow visualization in turbulent three-dimensional supersonic flows
[AD-A187982] N88-17714

FLOW VISUALIZATION
Development and application of oxygen flow tagging for velocity measurements and flow visualization in turbulent three-dimensional supersonic flows
[AD-A187982] N88-17714
Experimental research on swept shock wave/boundary layer interactions
[AD-A187250] N88-17957

FLUID DYNAMICS
Experimental research on swept shock wave/boundary layer interactions
[AD-A187250] N88-17957
Research on fluid dynamic energy separation
[DE88-002776] N88-18001
FLUID FLOW
Pumping systems and flow interfaces for rapid response electronic reheat controls N88-17665
One-dimensional leakage-flow vibration instabilities
[DE88-002875] N88-17947
Application of a multigrid method to a buoyancy-induced flow problem
[DE88-003961] N88-18326
FLUID JETS
Droplet formation for liquid monopropellant jets
[AD-A187172] N88-17956
FLUID MANAGEMENT
Study of helium transfer technology for STICCR: Fluid management
[NASA-CR-177463] N88-17720
FLUID POWER
Advanced energy conversion concept for beamed-energy propulsion
[AD-A187336] N88-17914
FLUORESCENCE
Investigation of real-time two-dimensional visualization of fuel spray liquid/vapor distribution via exciplex fluorescence
[AD-A188268] N88-17816
FLUORO COMPOUNDS
Flash threshold of shocked aluminum silicofluoride
[DE88-003978] N88-18005
FLUTTER
Parametric study of choke flutter with a linear theory N88-17673
The application of modern aeroelastic developments for future projects
[MBB-UT-007/87] N88-17850
FLUTTER ANALYSIS
An application of eigenspace methods to symmetric flutter suppression
[NASA-CR-181618] N88-17684
FLUX (RATE)
Johnson noise thermometer for high radiation and high temperature environments
[DE88-003770] N88-17911
Turbulence interactions in single- and multi-phase turbulent mixing and combustion processes
[AD-A187505] N88-17960
FLUX DENSITY
Experimental study of thermal loading at the wall of an industrial Diesel motor
[ISAL-IDI-187-10] N88-18000
Applications of energy density theory in cyclic plasticity
[AD-A186947] N88-18023
FOCUSING
Trace analysis by MS/MS on a double focussing mass spectrometer
[AD-A187954] N88-17973
Overview of applications of Laser-Induced Breakdown Spectroscopy (LIBS)
[DE88-004314] N88-17987
Generalized equations for emittance and field energy of high-current beams in periodic focusing
[DE88-004448] N88-18372
FOOD PROCESSING
International cooperative effort to establish ASTM (American Society for Testing and Materials) standards for the measurement of radiation dose for food processing
[DE88-002702] N88-18190
FOOTPRINTS
Maneuverable reentry vehicle trajectory footprints: Calculation and properties
[DE88-004726] N88-17726
FORBIDDEN TRANSITIONS
Theoretical studies of atomic transitions
[DE88-004719] N88-18389
FORCED VIBRATION
Flaw identification from forced vibration testing
[DE88-002641] N88-18018
FORECASTING
Forecasting complications of cardiovascular disease in flight personnel N88-18136
A comparison of projection methods in the forecasting of overhead costs for seven government aerospace contractors
[AD-A187572] N88-18514
FORESTS
Improved canopy reflectance modeling and scene inference through improved understanding of scene pattern
[NASA-CR-182488] N88-18049
FORTRAN
Debugging FORTRAN on a shared memory machine
[DE88-003589] N88-18276
FOURIER TRANSFORMATION
An infra-red investigation of HAN (Hydroxylammonium Nitrate)-based liquid propellants
[AD-A187226] N88-17815
Explicit approximations for strictly nonlinear oscillators with slowly varying parameters with applications to free electron lasers
[DE88-004116] N88-17984
FRACTIONATION
High-density jet fuels from coal syncrudes, appendix 4
[DE88-003132] N88-17813
FRACTOGRAPHY
Some aspects of the mechanics and mechanisms of dynamic brittle fracture N88-18028
FRACTURE MECHANICS
Applications of energy density theory in cyclic plasticity
[AD-A186947] N88-18023
Some aspects of the mechanics and mechanisms of dynamic brittle fracture N88-18028
Theoretical analysis of adhesive fracture and crack-damage interactions N88-18030
Fatigue crack growth due to random loading
[DE88-004641] N88-18038
Institute for Materials Science and Engineering, Fracture and Deformation Division: Technical activities, 1987
[PB88-153622] N88-18039
FRACTURE STRENGTH
Finite element substructuring methods for composite mechanics
[NASA-TM-100297] N88-17745
Some aspects of the mechanics and mechanisms of dynamic brittle fracture N88-18028
FRACTURES (MATERIALS)
Institute for Materials Science and Engineering, Fracture and Deformation Division: Technical activities, 1987
[PB88-153622] N88-18039
The influence of small defects on tensile specimen ductility and symmetry of deformation
[AD-A187983] N88-18044
FRACTURING
Acoustic emission-microstructural relations in ferritic steels. Part 3: The effect of inclusion content
[AERE-R-12041] N88-18015
Some aspects of the mechanics and mechanisms of dynamic brittle fracture N88-18028
Theoretical analysis of adhesive fracture and crack-damage interactions N88-18030
FRAMES (DATA PROCESSING)
A unified framework for approximation in inverse problems for distributed parameter systems
[NASA-CR-181621] N88-18346
FREE ELECTRON LASERS
Conceptual designs of a 50 NM FEL (Free-Electron Laser) oscillator and a 20-40 NM SASE (Self-Amplified Spontaneous Emission) amplifier
[DE88-003150] N88-17974
Emittance studies at the Los Alamos National Laboratory Free-Electron Laser (FEL)
[DE88-003146] N88-17975
Physics modeling support contract
[DE88-004039] N88-17980
Preliminary injector, accelerator, and beamline design for rf-linac-driven XUV free-electron lasers
[DE88-003185] N88-17983
Explicit approximations for strictly nonlinear oscillators with slowly varying parameters with applications to free electron lasers
[DE88-004116] N88-17984
Betatron oscillations in a free electron laser
[DE88-004859] N88-17990
Tapered wiggler analysis of high gain free electron laser oscillators
[AD-A187997] N88-17997
Where directed energy stands in strategic defense
[DE88-005092] N88-18365
The stability of free-electron lasers against filamentation
[DE88-004712] N88-18435
FREE RADICALS
Laser studies of the dynamics of free radical reactions
[DE88-004431] N88-17989
FREQUENCIES
Qualification of frequency response functions using the rigid-body response
[DE88-000745] N88-18033
Frequency response function estimation at level
[DE88-002644] N88-18034
FREQUENCY RESPONSE
Strategic placement of accelerometers to measure forces by the sum of weighted accelerations
[DE88-002262] N88-17968
FRICTION
Friction and wear of monolithic and fiber reinforced silicon-ceramics sliding against IN-718 alloy at 25 to 800 C in atmospheric air at ambient pressure
[NASA-TM-100294] N88-17796
Adhesion, friction and micromechanical properties of ceramics
[NASA-TM-100782] N88-17801
Tribology of ceramics: Report of the Committee on Tribology of Ceramics
[NASA-CR-182506] N88-17802
One-dimensional leakage-flow vibration instabilities
[DE88-002875] N88-17947
FRICTION REDUCTION
An evaluation of effectiveness of PTFE (polytetrafluoroethylene) type friction reducers on reducing friction and wear
[AD-A187440] N88-18010
FROUDE NUMBER
Centerplane source distribution for slender bodies N88-17940
FUEL CELLS
Determination of optimum electrolyte composition for molten carbonate fuel cells literature review
[DE88-001015] N88-18058
Advanced materials for solid oxide fuel cells
[DE88-002338] N88-18071
Fuel cell/battery hybrid vehicle assessment
[DE88-005087] N88-18520
FUEL CONSUMPTION
X-wing potential for Navy applications N88-17604
The advantage of variable geometry for turbine engines at low power N88-17653
Minimum Energy Routing through Interactive Techniques (MERIT) modeling
[NASA-CR-182535] N88-18105
FUEL PUMPS
Pumping systems and flow interfaces for rapid response electronic reheat controls N88-17665
FUEL SPRAYS
Investigation of real-time two-dimensional visualization of fuel spray liquid/vapor distribution via exciplex fluorescence
[AD-A188268] N88-17816
FUELS
The chemistry of the hypochlorite neutralization of hydrazine fuels
[DE88-002971] N88-17812
FUNCTIONAL ANALYSIS
Boundary value problems for differential and functional differential equations
[AD-A187378] N88-18349
Well-posedness and spectral estimation for infinite dimensional systems
[AD-A187621] N88-18354
FUNCTIONAL DESIGN SPECIFICATIONS
Supercritical fluid extraction-gas chromatography of Volatile Organic Compounds (VOC) from tenax devices
[PB88-124300] N88-17759
FUNCTIONS (MATHEMATICS)
Computation of the zeta-function of an algebraic curve with the differentials of the first kind
[PB88-127527] N88-18339
FUSION REACTORS
Conceptual design study of Fusion Experimental Reactor (FY86 FER): Safety
[DE88-751071] N88-18418
Diagnostics for ATF
[DE88-004175] N88-18438
ATF experimental plans
[DE88-004177] N88-18439
Zero-dimensional model of a reversed field pinch fusion reactor
[DE88-005213] N88-18442

G

GALACTIC EVOLUTION
The origin of the diffuse X-ray background and the formation of galaxies and voids N88-18527
GALAXIES
The origin of the diffuse X-ray background and the formation of galaxies and voids N88-18527
GALERKIN METHOD
Shuttle rocket booster computational fluid dynamics
[NASA-CR-182518] N88-17733
Dynamic response of some structural elements fabricated from a non-linear elastic material N88-18031
Comprehensive analysis of helicopters with bearingless rotors
[NASA-CR-182537] N88-18300
GALLIUM ARSENIDES
A payload for investigating the influence of convection on GaAs crystal growth N88-17702

Strength and structure of Ga sub 1-xIn sub xAs alloys
[AD-A186092] N88-17795
Wafer scale implementation of a GaAs systolic signal processor cell N88-18247
Grazing incidence X-ray scattering study of defect structures in MBE GaAs/Si using synchrotron radiation
[DE88-004556] N88-18483

GAMMA RAY LASERS
Extension of nuclear structure data base searches for gamma-ray laser candidates
[DE88-004288] N88-17985
A nuclear structure study of the proposed gamma-ray laser candidate nucleus Re-186
[DE88-004299] N88-17986

GAMMA RAY SPECTRA
Gamma-ray imaging observations of the Crab and Cygnus regions N88-18522

GAMMA RAY TELESCOPES
Gamma-ray imaging observations of the Crab and Cygnus regions N88-18522

GAMMA RAYS
Gamma-ray and neutron spectroscopy of planetary surfaces and atmospheres
[DE88-004287] N88-18541

GAS ANALYSIS
Analysis of gases in the earth's crust
[PB88-141619] N88-18093

GAS CHROMATOGRAPHY
Application of inverse gas chromatography to fluidity studies
[DE88-002896] N88-17750
Supercritical fluid extraction-gas chromatography of Volatile Organic Compounds (VOC) from tenax devices
[PB88-124300] N88-17759

GAS EXPANSION
A study of single and binary ion plasma expansion into laboratory-generated plasma wakes
[NASA-CR-4125] N88-18427

GAS FLOW
Development and application of oxygen flow tagging for velocity measurements and flow visualization in turbulent three-dimensional supersonic flows
[AD-A187982] N88-17714
Self-pumped phase conjugation in a supersonically flowing medium
[AD-A188281] N88-17998

GAS GENERATORS
Experimental evaluation of a translating nozzle sidewall radial turbine N88-17656
Design and aerodynamic performance of a small mixed-flow gas generator turbine N88-17662

GAS IONIZATION
On the role of the ionization frequency to gyrofrequency ratio in the critical ionization velocity interaction
[TRITA-EPP-86-10] N88-18414

GAS MIXTURES
Magnetic control of low pressure discharges
[AD-A186794] N88-17900

GAS PIPES
Analysis and application of the constant tensile load test for polyethylene gas pipe materials
[DE88-002868] N88-18037

GAS TURBINE ENGINES
Advanced Technology for Aero Gas Turbine Components
[AGARD-CP-421] N88-17647
The advantage of variable geometry for turbine engines at low power N88-17653
A research program on the aerodynamics of a highly loaded turbine stage N88-17655
Experimental evaluation of a translating nozzle sidewall radial turbine N88-17656
An integrated aero/mechanical performance approach to high technology turbine design N88-17657
Advanced techniques employed in blade cooling research N88-17659
Design and aerodynamic performance of a small mixed-flow gas generator turbine N88-17662
Possibilities for on-line surge suppression by fast guide vane adjustment in axial compressors N88-17674
Ceramic bearings for use in gas turbine engines
[NASA-TM-100288] N88-18007

GAS TURBINES
Wake interaction effects on the transition process on turbine blades
[AD-A188020] N88-17962

GATES (CIRCUITS)
Effect of the gate oxide thickness on the speed of MOS integrated circuits
[PB88-155783] N88-17910
Study of quantum mechanical effects in deep submicron, grating-gate field effect transistors
[AD-A188283] N88-17923

GAUGE INVARIANCE
Comment on the Adler-Bardeen theorem and related problems
[DE88-751051] N88-18367

GEARS
Gear systems for advanced turboprops N88-17667
Analysis of possible transmission arrangements applicable for driving single or twin counterrotating fans on propfan engines N88-17670

GENETICS
Investigation of genetic structures of rat germ cells following flight aboard Cosmos-1514 biosatellite during their prenatal development N88-18155

GEOCHEMISTRY
Earth materials research: Report of a Workshop on Physics and Chemistry of Earth Materials
[NASA-CR-182519] N88-17761
Analysis of gases in the earth's crust
[PB88-141619] N88-18093
Trace element geochemistry of the South Atlantic Bight
[DE88-003515] N88-18108

GEODESY
Five-diagonal weighting scheme for geoidal profiles
[AD-A188033] N88-18054
A smart, mapping, charting and geodesy control generator, phase 1
[AD-A188184] N88-18055
Estimation of gravity vector components from Bell gravity gradiometer and auxiliary data under consideration of topography and associated analytical upward continuation aspects
[AD-A188146] N88-18099

GEOGRAPHIC INFORMATION SYSTEMS
Air Force geographic information and analysis system
[DE88-001420] N88-18505

GEOIDS
Five-diagonal weighting scheme for geoidal profiles
[AD-A188033] N88-18054

GEOLOGY
Earth materials research: Report of a Workshop on Physics and Chemistry of Earth Materials
[NASA-CR-182519] N88-17761
Geological evolution and analysis of confirmed or suspected gas hydrate localities. Volume 10: Basin analysis, formation and stability of gas hydrates of the Aleutian Trench and the Bering Sea
[DE88-001006] N88-18048

GEOMAGNETISM
A study of the magnetic field annihilation process in the magnetosphere and some geotechnical applications
[DE88-004165] N88-18096

GEOMETRY
A finite element analysis of adhesively bonded composite joints including geometric nonlinearity, nonlinear viscoelasticity moisture diffusion and delayed failure
[AD-A187455] N88-17747
Design sensitivity analysis of nonlinear structural systems and numerical implementation with established finite element codes N88-18032
Computer aided geometric design
[AD-A187324] N88-18293

GEOMORPHOLOGY
Geological evolution and analysis of confirmed or suspected gas hydrate localities. Volume 10: Basin analysis, formation and stability of gas hydrates of the Aleutian Trench and the Bering Sea
[DE88-001006] N88-18048
Geological evolution and analysis of confirmed or suspected gas hydrate localities. Volume 9: Formation and stability of gas hydrates of the Middle America Trench
[DE88-001007] N88-18050

GEOPHYSICS
Earth materials research: Report of a Workshop on Physics and Chemistry of Earth Materials
[NASA-CR-182519] N88-17761
Three-dimensional transient electromagnetic modeling for exploration geophysics N88-18047
Solar-geophysical data number 517, September 1987. Part 1: (Prompt reports). Data for August, July 1987 and late data
[PB88-128426] N88-18544
Solar-geophysical data number 517, September 1987. Part 2: (Comprehensive reports). Data for March 1987 and miscellanea
[PB88-128434] N88-18545

GEOPOTENTIAL HEIGHT
Persistence characteristics of 500 mb blocking and zonal flows in the mid-latitudes of the Northern and Southern Hemispheres N88-18088

GEOSTROPHIC WIND
Analysis of quasi-geostrophic forcing during the AIMCS (Airborne Investigations of Mesoscale Convective Systems) Project. Volume 2: Results for June 14 through July 16, 1984
[PB88-123807] N88-18092

GEOTECHNICAL ENGINEERING
A study of the magnetic field annihilation process in the magnetosphere and some geotechnical applications
[DE88-004165] N88-18096

GERMANIUM
The migration of grain boundaries in ceramic materials with particular reference to the sintering process
[DE88-004085] N88-17808

GERMANIUM ALLOYS
Stability diagrams for epitaxial strained layers
[DE88-003935] N88-18470

GET AWAY SPECIALS (STS)
The 1987 Get Away Special Experimenter's Symposium
[NASA-CP-2500] N88-17691
Microgravity research at the University of Mexico: Experiments in payload G-008 N88-17692
Materials processing in space: An introduction to the G-480 payload N88-17695
Ten past and ten future GAS/MAUS-payloads N88-17696
An update to the MITRE/WPI Space Shuttle Program GASCAN G-408 N88-17697
Electrochemical growth of linear conducting crystals in microgravity N88-17698
Planet X probe: A fresh new look at an old familiar place N88-17699
Protein-crystal growth experiment (planned) N88-17700
The photons payload, G-494: A learning experience N88-17701
A payload for investigating the influence of convection on GaAs crystal growth N88-17702
An advanced microcomputer design for processing of semiconductor materials N88-17703
Project Explorer takes its second step: GAS-608 in engineering development N88-17707
GAS 450: A space payload for the People Central Coast Student Experimenters N88-17709
The NORSTAR Program: Space shuttle to space station N88-17710
Lightsats and their attraction to budget oriented Federal agencies N88-17711
GAS eleven node thermal model (GEM) N88-17712

GLACIOLOGY
NASA Oceanic Processes Program
[NASA-TM-4025] N88-18109

GLASS
Models for ionic transport in glass
[DE88-002860] N88-17799
Metal modification for improved glass-ceramic to metal seals: 1. Auger results on ion implantation and vapor deposition films
[DE88-005244] N88-18006

GLASS COATINGS
Short fiber reinforced thermoplastic composites for armor applications: Interfacial bonding
[DE88-004007] N88-17742

GLASS FIBERS
Fabrication and materials evaluation of high performance aligned ceramic fibre reinforced glass matrix composite
[AERE-R-12517] N88-17736

GLOBULAR CLUSTERS
The formation of single millisecond pulsars in globular clusters
[MPE-PREPRINT-97] N88-18525

GLOW DISCHARGES
Magnetic control of low pressure discharges
[AD-A186794] N88-17900

GLUTAMIC ACID
Human blood glutamic acid level with exposure to high ambient concentrations of ammonia N88-18134

GLYCOLS
Thermogravimetric analysis of polymeric materials for an intermediate temperature solid electrolyte
[DE88-004854] N88-17809

GOALS
Present stage of space medicine N88-18151
Energy-related atomic and molecular structure and scattering studies
[DE88-004246] N88-18386

GOLD
Order-disorder transition of Au and Pt (110) surfaces: The significance of relaxations and vibrations
[DE88-004651] N88-18473

GOVERNMENT/INDUSTRY RELATIONS
Lightsats and their attraction to budget oriented Federal agencies N88-17711

GOVERNMENTS
Journal of Research of the National Bureau of Standards, volume 92, number 5, September-October 1987
[PB88-124409] N88-18518
Journal of Research of the National Bureau of Standards, volume 92, number 6, November-December 1987
[PB88-138516] N88-18519
GRAIN BOUNDARIES
The migration of grain boundaries in ceramic materials with particular reference to the sintering process
[DE88-004085] N88-17808
Grain boundaries, planar defects and superconducting properties of YBa2Cu3O7
[DE88-003477] N88-18475
Simulation and processing of high resolution images of defects and interfaces in superconducting YBa2Cu3O7
[DE88-003856] N88-18480
GRAMMARS
Semi-applicative programming N88-18239
GRAND UNIFIED THEORY
Status of the electroweak theory
[DE88-002342] N88-18494
GRANULAR MATERIALS
Microscopic modeling of sound waves in granular material
[DE88-000348] N88-18375
GRAPH THEORY
Strategies for concurrent processing of complex algorithms N88-18236
Implementing logical variables on a graph reduction architecture N88-18252
GRAPHIC ARTS
Computer aided geometric design
[AD-A187324] N88-18293
GRAPHITE-EPOXY COMPOSITES
A fiber-resin micromechanics analysis of the delamination front in a DCB specimen
[NASA-TM-100540] N88-17737
GRASSLANDS
Evaluation of surface energy and radiation balance systems on the Konza Prairie
[NASA-CR-182534] N88-18097
GRATINGS (SPECTRA)
Study of quantum mechanical effects in deep submicron, grating-gate field effect transistors
[AD-A188283] N88-17923
GRAVITATION
On higher derivative gravity
[DE88-700619] N88-18090
Applications of Lie group methods to the equations of magnetohydrodynamics N88-18422
Hamiltonian approach to relativistic theory of gravity and to general relativity theory
[DE88-700404] N88-18492
GRAVITATION THEORY
On higher derivative gravity
[DE88-700619] N88-18090
Qualitative methods in nonhomogeneous cosmology
[DE88-700620] N88-18458
GRAVITATIONAL COLLAPSE
Supernova mechanisms: Before and after SN1987a
[DE88-003489] N88-18533
GRAVITATIONAL EFFECTS
Microgravity research at the University of Mexico: Experiments in payload G-006 N88-17692
Ten past and ten future GAS/MAUS-payloads N88-17696
Drosophila geotaxis as a tool for the study of aging N88-17706
Embryonic development of guppy in weightlessness N88-18127
Myosin Ca sup (2+), Mg sup (2+)-adenosine triphosphatase activity in ray myocardium following 30-day expose to 1.1 and 2.0 G N88-18141
Investigation of genetic structures of rat germ cells following flight aboard Cosmos-1514 biosatellite during their prenatal development N88-18155
Two-dimensional static otolith model N88-18167
Hemodynamic effects of beta-adrenergic blocking with obsidan in clinostatic and orthostatic positions N88-18171
NASA Workshop on Biological Adaptation
[NASA-TM-89468] N88-18174
GRAVITATIONAL FIELDS
Qualitative methods in nonhomogeneous cosmology
[DE88-700620] N88-18458
Hamiltonian approach to relativistic theory of gravity and to general relativity theory
[DE88-700404] N88-18492
GRAVITY GRADIOMETERS
Estimation of gravity vector components from Bell gravity gradiometer and auxiliary data under consideration of topography and associated analytical upward continuation aspects
[AD-A188146] N88-18099
GRAVITY WAVES
Universal power spectra for wave turbulence: Applications to wind waves, flicker noise, solar wind spectrum and classical second sound N88-17879
GRAZING INCIDENCE
Grazing incidence X-ray scattering study of defect structures in MBE GaAs/Si using synchrotron radiation
[DE88-004556] N88-18483
GREEN'S FUNCTIONS
Comment on the Adler-Bardeen theorem and related problems
[DE88-751051] N88-18367
GROUND EFFECT (AERODYNAMICS)
Recommendations for ground effects research for V/STOL and STOL aircraft and associated equipment for large scale testing
[NASA-CR-177429] N88-17585
GROUND WATER
Boundary-integral-equation method for computing the three-dimensional flow of groundwater
[PB88-126891] N88-17951
GROWTH
Synthesis and characterization of thin films
[AD-A187335] N88-18485
GUIDE VANES
Possibilities for on-line surge suppression by fast guide vane adjustment in axial compressors N88-17674
Experimental evaluation of turning vane designs for high-speed and coupled fan-drive corners of 0.1-scale model of NASA Lewis Research Center's proposed altitude wind tunnel
[NASA-TP-2681] N88-17686
GUN PROPELLANTS
Droplet formation for liquid monopropellant jets
[AD-A187172] N88-17956
GUSTS
Status of FAA terminal Doppler weather radar programs N88-17632
GYROFREQUENCY
On the role of the ionization frequency to gyrofrequency ratio in the critical ionization velocity interaction
[TRITA-EPP-86-10] N88-18414

H

HADRONS
Hadron-quark phase transition in dense stars
[DE88-003412] N88-18532
HAMILTONIAN FUNCTIONS
Hamiltonian approach to relativistic theory of gravity and to general relativity theory
[DE88-700404] N88-18492
HANDLEY PAGE AIRCRAFT
Sound transmission through the walls of light aircraft: An investigation of structure-borne noise in a Handley Page 137 Jetstream 3 aircraft
[NASA-CR-182509] N88-18376
HARDWARE
An applicative programmer's approach to matrix algebra, lessons for hardware and software N88-18251
HARTREE APPROXIMATION
Theoretical studies of atomic transitions
[DE88-004719] N88-18389
HAZARDS
Modeling of the non-auditory response to blast overpressure
[AD-A187397] N88-18184
HEAD DOWN TILT
Effect of antiorthostatic position and different illumination on sensitivity of skin in upper half of the body to ultraviolet radiation N88-18145
HEART DISEASES
Relationships between coronary heart disease risk factors and serum ionized calcium in Kennedy Space Center Cohort
[NASA-TM-100979] N88-18177
HEAT BALANCE
Approximate solutions of heat conduction in a medium with variable properties
[AD-A186933] N88-17925
HEAT EXCHANGERS
Microcomputer analysis of regenerative heat exchangers for oscillating flow
[DE88-001773] N88-17945
A solar receiver-reactor with specularly reflecting walls for high-temperature thermoelectrochemical and thermochemical processes
[AD-A187612] N88-18077
HEAT FLUX
Approximate solutions of heat conduction in a medium with variable properties
[AD-A186933] N88-17925
Experimental study of thermal loading at the wall of an industrial Diesel motor
[ISAL-IDI-187-10] N88-18000
HEAT MEASUREMENT
Time-resolved heat transfer measurements and analysis in the wage region of a cylinder in crossflow N88-17939
Experimental study of thermal loading at the wall of an industrial Diesel motor
[ISAL-IDI-187-10] N88-18000
Specific heat of novel thin-film material systems N88-18446
HEAT PUMPS
Free-piston Stirling engine diaphragm-coupled heat-actuated heat pump component technology program, phase 1C
[DE88-003654] N88-17949
Analysis of the performance of an air-water heat pump: Regulation of intrinsic performances
[DE88-900241] N88-18061
HEAT RESISTANT ALLOYS
Effects of ion implantation on cavitation erosion of a cobalt based metal/carbide alloy
[AD-A187239] N88-17793
HEAT STORAGE
Effect of storage thermal behavior in seasonal storage solar heating systems
[PB88-114236] N88-18067
HEAT TRANSFER
Application of Hoffman modulation contrast microscopy coupled with three-wavelength two-beam interferometry to the in situ direct observation of the growth process of a crystal in microgravity N88-17704
Effect of translucence of engineering ceramics on heat transfer in diesel engines
[DE88-003732] N88-17804
An experiment to investigate Rankine cycle two-phase microgravity issues
[DE88-004197] N88-17818
Mechanistic model for void distribution in flashing flow
[DE88-002948] N88-17928
Time-resolved heat transfer measurements and analysis in the wage region of a cylinder in crossflow N88-17939
Periodic natural convection in a rectangular enclosure of low aspect ratio N88-17941
Microcomputer analysis of regenerative heat exchangers for oscillating flow
[DE88-001773] N88-17945
Experimental studies of heat and mass exchange in parallel-passage rotary desiccant dehumidifiers for solar cooling applications
[DE88-001119] N88-18069
Physiological and ecological implications of coupled heat- and water-transport mechanisms of endotherms and vegetation
[DE88-004170] N88-18081
HEAT TREATMENT
Effect of post-cure heat-treatment on static and fatigue behaviour of XAS-914C carbon fibre composite
[AD-A186943] N88-17735
HEATING
Pumping systems and flow interfaces for rapid response electronic reheat controls N88-17665
The influence of the heating procedure on the oxidation behaviour of NiAl studied by XPS
[AERE-R-12498] N88-17776
A study of the magnetic field annihilation process in the magnetosphere and some geotechnical applications
[DE88-004165] N88-18096
Coronal heating by means of helical magnetohydrodynamic turbulence
[AD-A187084] N88-18413
HEATING EQUIPMENT
Research on fluid dynamic energy separation
[DE88-002776] N88-18001
HELICAL WINDINGS
On some asymptotics of laminar flow in a coiled pipe N88-17936
HELICOPTER CONTROL
Rotor SAR (ROSAR): A new high-resolution all-weather vision method for helicopters
[MBB-UA-1046/87] N88-17855
HELICOPTER DESIGN
Helicopter activities in Germany
[MBB-UD-487/86] N88-17853
Testing of a tail rotor system in a fiber composite type of construction
[MBB-UD-472/86] N88-17854
HELICOPTER PERFORMANCE
Rotorcraft weight trends in light of structural material characteristics
[AD-A186576] N88-17642
Helicopter activities in Germany
[MBB-UD-487/86] N88-17853
HELICOPTER TAIL ROTORS
Testing of a tail rotor system in a fiber composite type of construction
[MBB-UD-472/86] N88-17854

HELICOPTERS
Helicopter external vision requirements and visual display characteristics: A report/bibliography, revision A [AD-A187075] N88-17641
Research and development. Technical-scientific publications (1956-1987): Retrospective view and prospects. Jubilee edition on the occasion of the 75th birthday of Dipl.-Engr. Dr.-Engr. E. H. Ludwig Boelkow [ISSN-0931-9751] N88-17819
Special flight mechanical features of the bearingless helicopter rotor [MBB-FM-315/O] N88-17825
Comprehensive analysis of helicopters with bearingless rotors [NASA-CR-182537] N88-18300

HELIUM
State-to-state dynamics of molecular energy transfer [DE88-003282] N88-18382
Superfluid turbulence in He II at elevated pressures N88-18493

HELMET MOUNTED DISPLAYS
Helicopter external vision requirements and visual display characteristics: A report/bibliography, revision A [AD-A187075] N88-17641

HEMODYNAMIC RESPONSES
Effect of spaceflight factors on primate's blood circulation N88-18124

HEMODYNAMICS
Comparative evaluation of orthostatic stability following immersion in horizontal and vertical positions N88-18143
JPRS Report: Science and Technology. USSR: Space Biology and Aerospace Medicine, volume 21, no. 6, November - December 1987 [JPRS-USB-88-004] N88-18150
Effect of exogenous cardiosynchronized counterpulsation on human regional and central hemodynamics N88-18163
Hemodynamic effects of beta-adrenergic blocking with obsidan in clinostatic and orthostatic positions N88-18171

HEMOSTATICS
Role of carbon dioxide in correction of coagulation hemostasis under hypoxic conditions N88-18160

HETEROCYCLIC COMPOUNDS
Thermogravimetric analysis of polymeric materials for an intermediate temperature solid electrolyte [DE88-004854] N88-17809

HETEROGENEITY
Software support for heterogeneous machines N88-18224

HETEROJUNCTIONS
MBE growth, characterization and electronic device processing of HgCdTe, HgZnTe related heterojunctions and HgCdTe-CdTe superlattices [AD-A187456] N88-18486

HEURISTIC METHODS
A comparative study of heurstic algorithms for task assignment in distributed computing systems N88-18211

HIERARCHIES
Research and development trends for memory hierarchies — cache memories N88-18198
Hierachical object recognition using libraries of parameterized model sub-parts [AD-A187476] N88-18322

HIGH ALTITUDE ENVIRONMENTS
Polar worker adaptability to Antarctic high altitudes N88-18165

HIGH ENERGY ELECTRONS
Simulation and modeling of whistler mode wave growth through cyclotron resonance with energetic electrons in the magnetosphere N88-18089
Investigations of stimulated Raman scattering from high density underdense plasmas irradiated by a 0.35 micron laser N88-18421

HIGH ENERGY INTERACTIONS
High Z interaction physics on Nova [DE88-004397] N88-18433

HIGH FREQUENCIES
Wideband HF (High Frequency) modeling and simulation [PB88-116116] N88-17874
User's guide for the HF (High Frequency) broadcast antenna design and validation summary programs [PB88-116124] N88-17875

HIGH GAIN
Tapered wiggler analysis of high gain free electron laser oscillators [AD-A187997] N88-17997

HIGH LEVEL LANGUAGES
Optical symbolic processor for expert system execution [AD-A187494] N88-18268

HIGH PRESSURE
Radial compressor design using an Euler solver N88-17675
Design and testing of a front stage for an advanced high pressure compressor N88-17679

HIGH RESOLUTION
Rotor SAR (ROSAR): A new high-resolution all-weather vision method for helicopters [MBB-UA-1048/87] N88-17855
Experiments for the high resolution detection of moving targets using a CO2 laser radar [MBB-UA-1044/87] N88-17864
New generation imager system [NASA-CR-180464] N88-18398
High-resolution X-ray microstructural study of single crystals of YBa2Cu3O/sub 7-y/ [DE88-004856] N88-18484

HIGH SPEED
Experimental evaluation of turning vane designs for high-speed and coupled fan-drive corners of 0.1-scale model of NASA Lewis Research Center's proposed altitude wind tunnel [NASA-TP-2681] N88-17686

HIGH TEMPERATURE
A review of pitting corrosion in high temperature aqueous solutions [DE88-003547] N88-17787
Dynamic recrystallization during high temperature low cycle fatigue of nickel [DE88-003224] N88-17788
A solar receiver-reactor with specularly reflecting walls for high-temperature thermoelectrochemical and thermochemical processes [AD-A187612] N88-18077
High temperature processing of superconducting Y1Ba2Cu3O6.9 [DE88-003002] N88-18449
Electronic structure, charge transfer excitations and high temperature superconductivity [DE88-003096] N88-18453
Innovative arrangements for industry/DOE laboratory collaboration in high temperature superconductivity [DE88-004320] N88-18482

HIGH TEMPERATURE ENVIRONMENTS
An integrated aero/mechanical performance approach to high technology turbine design N88-17657
Johnson noise thermometer for high radiation and high temperature environments [DE88-003770] N88-17911

HIGH TEMPERATURE GASES
Evaluation of a temperature remote sensing technique [AD-A187885] N88-18053

HIGH THRUST
Development of circulation control technology for powered-lift STOL aircraft N88-17608

HILBERT SPACE
Computation of the zeta-function of an algebraic curve with the differentials of the first kind [PB88-127527] N88-18339
Eigenvalue problems [AD-A188069] N88-18356

HIPPARCOS SATELLITE
Deep space target location with Hubble Space Telescope (HST) and Hipparcos data [NASA-CR-182520] N88-18524

HISTOCHEMICAL ANALYSIS
Histomorphometric analysis of rat bones after spaceflight aboard Cosmos-1667 biosatellite N88-18128
Muscle preservation in the study of bioenergetic effects of hypokinesia N88-18139
Investigation of rat skeletal muscles following short-term spaceflight aboard Cosmos-1667 biosatellite N88-18157

HISTORIES
The coming revolution in turbine engine technology N88-17648
Airbus, the successful European cooperation [MBB-UT-005/87] N88-17847
Messerschmitt-Boelkow-Blohm: A company with a tradition N88-17866
Messerschmitt-Boelkow-Blohm: Biography and history of a company N88-17867
Present stage of space medicine N88-18151
Antimatter: Its history and its properties [DE88-004308] N88-18498

HOMEOSTASIS
JPRS Report: Science and Technology. USSR: Space Biology and Aerospace Medicine, volume 21, no. 5, September - October 1987 [JPRS-USB-88-003] N88-18122
Effect of spaceflight factors on primate hydration homeostasis N88-18126
Discrete adaptation to sensory conflict N88-18146

HOMOGENEITY
The h-p version of the finite element method for problems with nonhomogeneous essential boundary condition [AD-A187356] N88-18348
Inversion of parabolic and paraboloidal projections [AD-A187538] N88-18380

HORIZONTAL FLIGHT
Flap-lag-torsion aeroelastic stability of a circulation control rotor in forward flight N88-17600

HORIZONTAL ORIENTATION
Study on a rotor speed control system for a horizontal axis windmill [NAL-TR-931] N88-18062

HORMONES
Certain aspects of human metabolism during spaceflights of varying duration [NASA-TT-20215] N88-18181

HOT ELECTRONS
Investigations of stimulated Raman scattering from high density underdense plasmas irradiated by a 0.35 micron laser N88-18421

HOT PRESSING
Fabrication and materials evaluation of high performance aligned ceramic fibre reinforced glass matrix composite [AERE-R-12517] N88-17736

HUBBLE SPACE TELESCOPE
Deep space target location with Hubble Space Telescope (HST) and Hipparcos data [NASA-CR-182520] N88-18524

HUMAN BEINGS
Experimental measurements of the uptake of ozone in rats and human subjects [PB88-125422] N88-18149
Certain aspects of human metabolism during spaceflights of varying duration [NASA-TT-20215] N88-18181
Modeling of the non-auditory response to blast overpressure [AD-A187397] N88-18184
Methods of eliciting information from experts [AD-A187468] N88-18189

HUMAN FACTORS ENGINEERING
Information transfer in the National Airspace System N88-17634

HUMAN PERFORMANCE
Second All-Union Conference on Physiology of Extreme States and Individual Protection of Man N88-18147

HUMAN TOLERANCES
Improvement of human tolerance to head-pelvis (+Gz) accelerations by increasing hydration N88-18153

HUMIDITY
Corrosion and deterioration testing in humid tropic environments [AD-A186917] N88-17783

HYDRATES
Gas hydrate model development and validation [DE88-001004] N88-17762
Geological evolution and analysis of confirmed or suspected gas hydrate localities. Volume 9: Formation and stability of gas hydrates of the Middle America Trench [DE88-001007] N88-18050

HYDRATION
Effect of spaceflight factors on primate hydration homeostasis N88-18126
Improvement of human tolerance to head-pelvis (+Gz) accelerations by increasing hydration N88-18153
Morphological and functional state of the hypothalamo-hypophyseal neurosecretory system of rats flown aboard Cosmos-1667 N88-18156

HYDRAZINES
The chemistry of the hypochlorite neutralization of hydrazine fuels [DE88-002971] N88-17812

HYDRIDES
Metal hydrides [DE88-005083] N88-17766

HYDROCRACKING
High-density jet fuels from coal syncrudes, appendix 4 [DE88-003132] N88-17813

HYDRODYNAMICS
The use of optical fibers for shock pressure and timing measurements at high pressures [DE88-004012] N88-17971
Energy transfers for multilayer hydrodynamic ocean models: General formulation and specific examples [AD-A187604] N88-18116

HYDROGEN
Hydrogen Energy Coordinating Committee: Summary of DOE hydrogen programs for FY 1987 [DE88-003960] N88-17811
Two-photon (VUV and visible) resonant ionization spectroscopy of atoms and molecules [DE88-004332] N88-18388

HYDROGEN ATOMS
On the dynamical supersymmetry of atomic hydrogen
[DE88-700713] N88-18495
HYDROGEN FUELS
Hydrogen Energy Coordinating Committee: Summary of DOE hydrogen programs for FY 1987
[DE88-003960] N88-17811
HYDROGEN IONS
An infra-red investigation of HAN (Hydroxylammonium Nitrate)-based liquid propellants
[AD-A187226] N88-17815
HYDROGENATION
High-density jet fuels from coal syncrudes, appendix 4
[DE88-003132] N88-17813
HYDROXIDES
Electron transfer to iron(3) oxide colloids
[DE88-002885] N88-18448
HYDROXYL COMPOUNDS
An infra-red investigation of HAN (Hydroxylammonium Nitrate)-based liquid propellants
[AD-A187226] N88-17815
HYPERBOLIC DIFFERENTIAL EQUATIONS
A study of numerical methods for hyperbolic conservation laws with stiff source terms
[NASA-TM-100075] N88-18343
HYPERCAPNIA
Effect of hypercapnic-hypoxic test on cariorespiratory parameters of individuals with neurocirculatory dystonia
N88-18169
HYPERCUBE MULTIPROCESSORS
The next generation of hypercube computers
N88-18226
Investigations on the usefulness of the Massively Parallel Processor for study of electronic properties of atomic and condensed matter systems
[NASA-CR-182514] N88-18259
Experiences with serial and parallel algorithms for channel routing using simulated annealing
[NASA-CR-182530] N88-18289
HYPERFINE STRUCTURE
Fundamental properties of spin-polarized quantum systems
[DE88-004425] N88-18499
HYPEROXIA
Effect of oxygen inhalation on respiratory function during exercise and exposure to added resistance to respiration
N88-18164
HYPERSONIC FLOW
Three-dimensional Euler solutions for hypersonic Mach numbers
[MBB-UR-944/87] N88-17859
A study of numerical methods for hyperbolic conservation laws with stiff source terms
[NASA-TM-100075] N88-18343
Hypersonic blunt body computations including real gas effects
[NASA-TM-100074] N88-18344
HYPERSONIC REENTRY
Three-dimensional Euler solutions for hypersonic Mach numbers
[MBB-UR-944/87] N88-17859
HYPERTENSION
Hemodynamic effects of beta-adrenergic blocking with obsidan in clinostatic and orthostatic positions
N88-18171
HYPERVELOCITY GUNS
Pulsed current transformer for low inductive loads
[AD-A187224] N88-17913
HYPERVELOCITY IMPACT
An analysis of penetration and ricochet phenomena in oblique hypervelocity impact
[NASA-TM-100319] N88-18004
HYPOKINESIA
JPRS Report: Science and Technology. USSR: Space Biology and Aerospace Medicine, volume 21, no. 5, September - October 1987
[JPRS-USB-88-003] N88-18122
Isotope methods of determining distribution and movement of blood in the body N88-18138
JPRS Report: Science and Technology. USSR: Space Biology and Aerospace Medicine, volume 21, no. 6, November - December 1987
[JPRS-USB-88-004] N88-18150
Morphological study of early changes in rat bones in simulated weightlessness N88-18158
Lipid peroxidation in rat tissues with exposure to antiorthostatic hypokinesia, exercise and immobilization stress N88-18159
New book on metabolic aspects of spaceflight stress
N88-18172
HYPOTHALAMUS
Morphological and functional state of the hypothalamo-hypophyseal neurosecretory system of rats flown aboard Cosmos-1667 N88-18156
HYPOXIA
Role of carbon dioxide in correction of coagulation hemostasis under hypoxic conditions N88-18160
Polar worker adaptability to Antarctic high altitudes
N88-18165
Combined effect of ionizing radiation and altered gas atmosphere on central nervous system N88-18168
Effect of hypercapnic-hypoxic test on cariorespiratory parameters of individuals with neurocirculatory dystonia
N88-18169

I

ICE
Radar reflectivity and attenuation of radio waves in the melting layer of precipitation
[PB88-121553] N88-17882
ICE FORMATION
Physical and structural characteristics of Weddell Sea pack ice
[AD-A188189] N88-18119
IGNITION
EXPLO: Explosives thermal analysis computer code
[DE88-001938] N88-17814
Flash threshold of shocked aluminum silicofluoride
[DE88-003978] N88-18005
D-3He fuels in a field-reversed configuration
[IPPJ-855] N88-18419
ILLINOIS
TABLET: The personal computer of the year 2000
[NASA-CR-182528] N88-18267
IMAGE INTENSIFIERS
Signal processing studies program optical signal amplification, volume 1
[AD-A188055] N88-17897
Performance of a photon counting microchannel plate intensifier with wedge and strip image readout
[DE88-003831] N88-17970
IMAGE MOTION COMPENSATION
Relaxing the brightness constancy assumption in computing optical flow
[AD-A187437] N88-18410
IMAGE PROCESSING
Transport delay compensation for computer-generated imagery systems
[NASA-TM-100084] N88-17645
Instrumentation and quantitative methods of evaluation
[DE87-013639] N88-18017
A smart, mapping, charting and geodesy control generator, phase 1
[AD-A188184] N88-18055
Autocorrelation of control points on 11-band multispectral imagery
[AD-A188185] N88-18056
Image texture classification with an optical crossbar interconnected processor N88-18202
New generation imager system
[NASA-CR-180464] N88-18398
Multidimensional system analysis of electro-optic sensors with sampled deterministic output
[AD-A187083] N88-18399
Simulation and processing of high resolution images of defects and interfaces in superconducting YBa2Cu3O7
[DE88-003856] N88-18480
Air Force geographic information and analysis system
[DE88-001420] N88-18505
IMAGE TRANSDUCERS
Cryogenic acoustic microscopy
[AD-A187274] N88-17767
IMAGERY
Performance of a photon counting microchannel plate intensifier with wedge and strip image readout
[DE88-003831] N88-17970
Autocorrelation of control points on 11-band multispectral imagery
[AD-A188185] N88-18056
IMAGING TECHNIQUES
NMR (Nuclear Magnetic Resonance) imaging for detecting binder/plasticizers in green-state structural ceramics
[DE88-003111] N88-17800
Digital imaging techniques for single- and multi-phase reacting flowfields N88-17933
Instrumentation and quantitative methods of evaluation
[DE87-013639] N88-18017
IMMOBILIZATION
Lipid peroxidation in rat tissues with exposure to antiorthostatic hypokinesia, exercise and immobilization stress N88-18159
New book on metabolic aspects of spaceflight stress
N88-18172
IMMUNOLOGY
Supersonic and subsonic aircraft noise effects on animals: A literature survey
[AD-A186922] N88-18373
IMPACT
Quantitative and qualitative assessments of the impact of linguistic theory on information science N88-18507
IMPACT DAMAGE
Space station integrated wall damage and penetration damage control. Task 5: Space debris measurement, mapping and characterization system
[NASA-CR-179281] N88-17688
An analysis of penetration and ricochet phenomena in oblique hypervelocity impact
[NASA-TM-100319] N88-18004
IMPACT LOADS
Spatial pressure variations and three-dimensional effects on liquid sloshing loads
[PB88-120134] N88-17926
IMPACT STRENGTH
Effect of low-temperature aging on the mechanical properties of cast stainless steels
[DE88-002872] N88-17774
IMPEDANCE MATCHING
The design of impedance- matching networks for broadband antennas
[AD-A187600] N88-17895
IMPEDANCE MEASUREMENT
Operators manual for a computer controlled impedance measurement system
[AD-A187513] N88-17917
IMPELLERS
Secondary flow measurements with L2F-technique in centrifugal compressors N88-17676
IMPURITIES
Mechaniams of intergranular attack and stress corrosion cracking of alloy 600 by high-temperature caustic solutions containing impurities
[DE87-012820] N88-17773
Influence of non-metallic elements in the mechanical properties of 20 Mn Mo Ni 55 steel
[DE88-700412] N88-17775
The effect of magnetic impurities and barriers on the magnetization and critical current of fine filament NbTi composites
[DE88-004443] N88-18472
IN-FLIGHT MONITORING
Flight testing of fighter aircraft
[MBB/LKE-62/S/PUB/292] N88-17844
INCLUSIONS
Acoustic emission-microstructural relations in ferritic steels. Part 3: The effect of inclusion content
[AERE-R-12041] N88-18015
INCOMPRESSIBLE BOUNDARY LAYER
Boundary layer calculation using digital computers
[REPT-MM-4] N88-17821
INCOMPRESSIBLE FLOW
Implicit solution of the incompressible Navier-Stokes equations in primitive variables on non-staggered grids
N88-17930
INCOMPRESSIBLE FLUIDS
Well-posedness and spectral estimation for infinite dimensional systems
[AD-A187621] N88-18354
INDIA
Director of R and D institutions (Government of India)
[PB88-127162] N88-17685
INDIUM
Strength and structure of Ga sub 1-xIn sub xAs alloys
[AD-A188092] N88-17795
INDUCTANCE
Pulsed current transformer for low inductive loads
[AD-A187224] N88-17913
Comparative evaluation of resistive and inductive techniques for measuring temperature of superconducting transition
[DE88-700603] N88-18457
INDUSTRIAL MANAGEMENT
Research, development, and growth strategy
N88-17820
Operations research in management?
[MBB-Z-138/87] N88-17835
Messerschmitt-Boelkow-Blohm, the company today. Data, numbers and facts N88-17868
INDUSTRIES
The development of emission tomography for the nuclear industry
[AERE-R-12319] N88-18014
INERTIAL CONFINEMENT FUSION
High Z interaction physics on Nova
[DE88-004397] N88-18433
The stability of free-electron lasers against filamentation
[DE88-004712] N88-18435
Diagnostics for ATF
[DE88-004175] N88-18438

ATF experimental plans
[DE88-004177] N88-18439
INERTIAL FUSION (REACTOR)
Design issues for a laboratory high gain fusion facility
[DE88-004406] N88-18434
INFORMATION
Resonance, information, and the primacy of process: Ancient light on modern information and communication theory and technology N88-18506
INFORMATION DISSEMINATION
Inexpensive solution for the mass distribution of satellite images
[PB88-114038] N88-17873
INFORMATION RETRIEVAL
Inexpensive solution for the mass distribution of satellite images
[PB88-114038] N88-17873
A hypertext writing environment and its cognitive basis
[AD-A186179] N88-18298
Using SIR (Scientific Information Retrival) system for data management during a field program
[DE88-001555] N88-18508
INFORMATION SYSTEMS
Wide band data transmission system using optical fibers
[DE88-004555] N88-17889
Methods of eliciting information from experts
[AD-A187468] N88-18189
Automated data flow diagram verification N88-18255
Air Force geographic information and analysis system
[DE88-001420] N88-18505
Computer-Aided Design Information System (CADIS): User's manual
[DE88-004365] N88-18509
Guidelines for exchanging computerized information
[DE88-004736] N88-18510
INFORMATION THEORY
Resonance, information, and the primacy of process: Ancient light on modern information and communication theory and technology N88-18506
Quantitative and qualitative assessments of the impact of linguistic theory on information science N88-18507
INFORMATION TRANSFER
Airborne Wind Shear Detection and Warning Systems: First Combined Manufacturers' and Technologists' Conference
[NASA-CP-10006] N88-17616
Information transfer in the National Airspace System N88-17634
Minutes of the meeting of the Indo-US Subcommission on Science and Technology (8th) held at Washington, D.C. on September 22-24, 1986
[PB88-130158] N88-18503
INFRARED INSTRUMENTS
Infrared low-level wind shear work N88-17628
INFRARED LASERS
Energy transfer studies with lasers
[DE88-004864] N88-17991
INFRARED RADIOMETERS
Forward looking wind shear detection N88-17629
INFRARED SPECTROSCOPY
An infra-red investigation of HAN (Hydroxylammonium Nitrate)-based liquid propellants
[AD-A187226] N88-17815
INJECTORS
Preliminary injector, accelerator, and beamline design for rf-linac-driven XUV free-electron lasers
[DE88-003185] N88-17983
INJURIES
Modeling of the non-auditory response to blast overpressure
[AD-A187397] N88-18184
INLET FLOW
Parametric study of choke flutter with a linear theory N88-17673
Experimental investigation of a supercritical compressor rotor blade section N88-17680
INPUT
A queusing system with independent Markov input streams
[AD-A187601] N88-18363
INSTRUMENT COMPENSATION
Corner compensation structures for (110) oriented silicon
[DE88-003300] N88-18455
INSULATION
The assessment of the sound insulation requirements for a large broadcasting studio, using a scale model: Practical details
[BBC-RD-1987/21] N88-17878
INTAKE SYSTEMS
The advantage of variable geometry for turbine engines at low power N88-17653
Investigation of dihedral effects in compressor cascades N88-17672
Wake interaction effects on the transition process on turbine blades
[AD-A188020] N88-17962
INTEGRAL EQUATIONS
Conjugate gradient spectral iterative technique
[PB88-126917] N88-18337
Small degree solutions for the polynomial Bezout equation
[AD-A187630] N88-18355
INTEGRATED CIRCUITS
Effect of the gate oxide thickness on the speed of MOS integrated circuits
[PB88-155783] N88-17910
Time domain wave propagation in multilayered integrated circuits
[AD-A187462] N88-17916
Formal multilevel hierarchical verification of synchronous MOS VLSI circuits
[AD-A187532] N88-17918
The soft/hard wet anodization of aluminum oxide and its use in a thin film multilayered capacitor
[AD-A187575] N88-17919
Signal processing studies program VLSI designs for unary functions
[AD-A188053] N88-17922
The arithmetic cube and its associated algorithms N88-18195
INTERFACE STABILITY
Microscopic control of metallization stability
[AD-A187553] N88-18487
CdTe(110)-Mn interface reaction and the formation of non-equilibrium ternary semimagnetic semiconductor alloys
[AD-A187593] N88-18491
INTERFACES
Crew interface with windshear systems N88-17631
Short fiber reinforced thermoplastic composites for armor applications: Interfacial bonding
[DE88-004007] N88-17742
Ytterbium monolayer diffusion barriers at Hg(1-x)Cd(x)Te/Al junctions
[AD-A188013] N88-17768
A detailed microstructural examination of the cause of HAZ cracking in type 316 steel
[AERE-R-12428] N88-17777
MTI-Interface (Moving Target Indication-Interface) for simple radar
[PB88-126578] N88-17884
Monitoring interfacial dynamics by pulsed laser techniques
[DE88-003362] N88-17976
Energy transfers for multilayer hydrodynamic ocean models: General formulation and specific examples
[AD-A187804] N88-18116
Chips: A tool for developing software interfaces interactively
[AD-A187499] N88-18295
Application of Onsager's reciprocity relations to interface motion
[DE88-003286] N88-18327
Local stoichiometry and atomic interdiffusion during reactive metal/mercury-cadmium-telluride junction formation
[AD-A187554] N88-18488
Nonmonotonic evolution and thermodynamic trends at metal/(Hg,Cd)Te interfaces: Yb/Hg0.78Cd0.22Te
[AD-A187591] N88-18490
CdTe(110)-Mn interface reaction and the formation of non-equilibrium ternary semimagnetic semiconductor alloys
[AD-A187593] N88-18491
INTERFERENCE
Wideband HF (High Frequency) modeling and simulation
[PB88-116116] N88-17874
INTERFERENCE FIT
Computed stress and strain distributions under interference fit and after coldworking
[AD-A186950] N88-18024
INTERFEROMETRY
Application of Hoffman modulation contrast microscopy coupled with three-wavelength two-beam interferometry to the in situ direct observation of the growth process of a crystal in microgravity N88-17704
Interferometric study of natural convection heat transfer from a vertical flat plate with transverse roughness elements N88-17935
INTERGRANULAR CORROSION
Mechanisms of intergranular attack and stress corrosion cracking of alloy 600 by high-temperature caustic solutions containing impurities
[DE87-012820] N88-17773
INTERMETALLICS
Superconductivity of thin film intermetallic compounds
[AD-A187563] N88-18489
INTERNAL COMBUSTION ENGINES
Multidimensional modeling of convective heat transfer with application to IC engines
[DE88-003398] N88-17948
An evaluation of effectiveness of PTFE (polytetrafluoroethylene) type friction reducers on reducing friction and wear
[AD-A187440] N88-18010
Fuel cell/battery hybrid vehicle assessment
[DE88-005087] N88-18520
INTERNAL ENERGY
Product kinetic and internal energy distributions via velocity-aligned Doppler spectroscopy
[DE88-003510] N88-17764
INTERNATIONAL COOPERATION
The NORSTAR Program: Space shuttle to space station N88-17710
Cooperation know-how in high-tech products
[MBB-Z-101/86] N88-17833
Airbus, the successful European cooperation
[MBB-UT-005/87] N88-17847
Messerschmitt-Boelkow-Blohm, the company today. Data, numbers and facts N88-17868
Minutes of the meeting of the Indo-US Subcommission on Science and Technology (8th) held at Washington, D.C. on September 22-24, 1986
[PB88-130158] N88-18503
Journal of Research of the National Bureau of Standards, volume 92, number 5, September-October 1987
[PB88-124409] N88-18518
Journal of Research of the National Bureau of Standards, volume 92, number 6, November-December 1987
[PB88-138516] N88-18519
INTERNATIONAL TRADE
Cooperation know-how in high-tech products
[MBB-Z-101/86] N88-17833
INTERPLANETARY MEDIUM
Extended atmospheres of outer planet satellites and comets
[NASA-CR-181449] N88-18540
INTERPLANETARY SPACE
Personal overview of solar wind 6
[DE88-003147] N88-18543
INTERPOLATION
Fast and practical parallel polynomial interpolation
[DE88-003530] N88-18328
INTERPROCESSOR COMMUNICATION
Multi-processor reduction machines N88-18253
INTERSTITIALS
Diffusion studies in amorphous NiZr alloys
[DE88-003009] N88-17781
INVARIANCE
Status of the electroweak theory
[DE88-002342] N88-18494
INVERSE SCATTERING
Direct scattering of electromagnetic waves by one- and two-dimensional objects and its use for inverse profiling
[PB88-126909] N88-17887
INVERSIONS
Improved canopy reflectance modeling and scene inference through improved understanding of scene pattern
[NASA-CR-182488] N88-18049
Inversion of parabolic and paraboloidal projections
[AD-A187538] N88-18380
INVESTIGATION
CTD observations in the coastal transition zone off northern California, 16-25 February 1987
[AD-A187263] N88-18111
INVISCID FLOW
Supersonic aerodynamics of delta wings
[NASA-TP-2771] N88-17615
The unsteady gas flow through stator and rotor of a turbomachine N88-17660
Well-posedness and spectral estimation for infinite dimensional systems
[AD-A187621] N88-18354
IODINE
State-to-state dynamics of molecular energy transfer
[DE88-003282] N88-18382
ION BEAMS
Application of ECR ion source beams in atomic physics
[DE88-003767] N88-18384
Optimization of outlet channel of plasma ion source
[DE88-700471] N88-18415
ION IMPLANTATION
Effects of ion implantation on cavitation erosion of a cobalt based metal/carbide alloy
[AD-A187239] N88-17793
Metal modification for improved glass-ceramic to metal seals: 1. Auger results on ion implantation and vapor deposition films
[DE88-005244] N88-18006
Formation of optical waveguides by ion implantation
[DE88-003894] N88-18407

ION SOURCES
Application of ECR ion source beams in atomic physics
[DE88-003767] N88-18384
Optimization of outlet channel of plasma ion source
[DE88-700471] N88-18415
IONIC DIFFUSION
GAS 457: A space payload for the People Central Coast Student Experimenters N88-17709
IONIZATION
An analytic model for ionization distributions produced in nanometer sites by protons
[DE88-003943] N88-18385
Chemical activation of molecules by metals: Experimental studies of electron distributions and bonding
[DE88-004465] N88-18393
Synthesis and characterization of thin films
[AD-A187335] N88-18485
IONIZATION FREQUENCIES
On the role of the ionization frequency to gyrofrequency ratio in the critical ionization velocity interaction
[TRITA-EPP-86-10] N88-18414
IONIZING RADIATION
Combined effect of ionizing radiation and altered gas atmosphere on central nervous system N88-18168
IONOSPHERIC PROPAGATION
Wideband HF (High Frequency) modeling and simulation
[PB88-116116] N88-17874
User's guide for the HF (High Frequency) broadcast antenna design and validation summary programs
[PB88-116124] N88-17875
IONS
Models for ionic transport in glass
[DE88-002880] N88-17799
Ion chromatography in the manufacture of multilayer circuit boards
[DE88-002428] N88-17902
A study of the magnetic field annihilation process in the magnetosphere and some geotechnical applications
[DE88-004165] N88-18096
IRON ALLOYS
Response of Fe-Cr-Mn austenitic alloys to thermal aging neutron irradiation
[DE88-003415] N88-17785
IRON OXIDES
Electron transfer to iron(3) oxide colloids
[DE88-002885] N88-18448
IRRADIANCE
Bright source lasers and experiments at very high irradiance
[DE88-004317] N88-17988
IRRADIATION
Irradiation effects in metals
[DE88-004272] N88-17789
International cooperative effort to establish ASTM (American Society for Testing and Materials) standards for the measurement of radiation dose for food processing
[DE88-002702] N88-18190
NBS (National Bureau of Standards) measurement services: Spectral irradiance calibrations
[PB88-123781] N88-18401
Investigations of stimulated Raman scattering from high density underdense plasmas irradiated by a 0.35 micron laser N88-18421
Effects of X irradiation and high field electron injection on the electrical properties of rapid thermal oxides
[DE88-002642] N88-18461
ISOTOPES
Analysis of gases in the earth's crust
[PB88-141619] N88-18093
ISOTOPIC LABELING
Isotope methods of determining distribution and movement of blood in the body N88-18138
ITERATIVE SOLUTION
Centerplane source distribution for slender bodies N88-17940
Quasigroup approach to solution of linear algebraic equation systems
[DE88-700595] N88-18330
Leapfrog variants of iterative methods for linear algebra equations
[NASA-CR-181616] N88-18332
Conjugate gradient spectral iterative technique
[PB88-126917] N88-18337
Spectral iterative technique with Gram-Schmidt orthoganalization
[PB88-127451] N88-18338

J

J-57 ENGINE
Operation of gas turbine engines in dust-laden environments N88-17654
JET ENGINE FUELS
High-density jet fuels from coal syncrudes, appendix 4
[DE88-003132] N88-17813
JET ENGINES
Optimisation of military compressors for weight and volume N88-17649
An examination of the impact of potential advances in component technology for future military engines N88-17650
Specification of an engine and its components starting from a consideration of aircraft missions N88-17651
Application of highly loaded single-stage mixed-flow compressors in small jet-engines N88-17652
Aerodynamic performance of a scale-model, counter-rotating unducted fan N88-17666
Design and development of an advanced F100 compressor N88-17678
JET FLOW
Wind tunnel studies of circulation control elliptical airfoils N88-17598
Investigation of non-symmetric jets in cross flow N88-17932
Droplet formation for liquid monopropellant jets
[AD-A187172] N88-17956
Numerical simulations of the California current: Filament formation as related to baroclinic instability
[AD-A187573] N88-18115
JET NOZZLES
Design of supersonic Coanda jet nozzles N88-17599
JET PROPULSION
Rocket and airjet propulsion for ballistic and aerodynamic space probes
[REPT-TR-527] N88-17826
JOINTS (JUNCTIONS)
A finite element analysis of adhesively bonded composite joints including geometric nonlinearity, nonlinear viscoelasticity moisture diffusion and delayed failure
[AD-A187455] N88-17747
Design conditions and workspace for the generally-proportioned 3-hinge spherical wrist for robots N88-18003
Computed stress and strain distributions under interference fit and after coldworking
[AD-A186950] N88-18024
JOURNAL BEARINGS
The use of multigrid techniques in the solution of the Elrod algorithm for a dynamically loaded journal bearing
[NASA-CR-180873] N88-17954

K

KANSAS
Evaluation of surface energy and radiation balance systems on the Konza Prairie
[NASA-CR-182534] N88-18097
KEROSENE
High-density jet fuels from coal syncrudes, appendix 4
[DE88-003132] N88-17813
KINETIC ENERGY
Product kinetic and internal energy distributions via velocity-aligned Doppler spectroscopy
[DE88-003510] N88-17764
Energy transfers for multilayer hydrodynamic ocean models: General formulation and specific examples
[AD-A187604] N88-18116
KINETIC EQUATIONS
Application of Onsager's reciprocity relations to interface motion
[DE88-003286] N88-18327
Applied mathematics of transport theory
[DE88-004098] N88-18369
KLYSTRONS
The numerical simulation of accelerator components
[DE87-011597] N88-18423
KNOWLEDGE
The representation of knowledge within model-based control systems
[DE88-004863] N88-18319
KNOWLEDGE REPRESENTATION
Knowledge base refinement by monitoring abstract control knowledge, revision 1
[AD-A187502] N88-18323
KRYPTON
Two-photon (VUV and visible) resonant ionization spectroscopy of atoms and molecules
[DE88-004332] N88-18388

L

LABORATORIES
Helsinki University of Technology Communications Laboratory
[PB88-112974] N88-17881
Laboratory evaluation and analysis of advanced lead-acid load-leveling batteries
[DE88-002851] N88-18064
LAGRANGE SIMILARITY HYPOTHESIS
Fully Lagrangian Renormalized Approximation theory of fluid turbulence
[DE88-004960] N88-17952
LAMINAR BOUNDARY LAYER
Boundary layer calculation using digital computers
[REPT-MM-4] N88-17821
Velocity measurements in a 3D (three dimensional) shock wave laminar boundary layer interaction
[AD-A187334] N88-17959
LAMINAR FLOW
Solution of the three-dimensional Navier-Stokes equations for transonic flow using a multigrid method N88-17579
On some asymptotics of laminar flow in a coiled pipe N88-17936
LAMINATES
An analytical study of the effects of transverse shear deformation and anisotropy on natural vibration frequencies of laminated cylinders
[NASA-TM-100554] N88-17739
Analytical and experimental characterization of damage processes in composite laminates
[AD-A187221] N88-17746
Piezoelectric laminates for torsional and bending model control: Theory and experiment N88-18029
Ultrasonic characterization of layered composite systems N88-18374
LAND USE
Air Force geographic information and analysis system
[DE88-001420] N88-18505
LANDING
Radar returns from ground clutter in vicinity of airports N88-17624
LANDSAT SATELLITES
Space-based remote sensing of the Earth: A report to the Congress
[NASA-TM-89709] N88-18046
LANGUAGE PROGRAMMING
Design for a TPL complier system: A system for retargeting high level language programs N88-18248
LARGE SPACE STRUCTURES
Sensitivity of active vibration control to structural changes and model reduction N88-17683
Formulation methods of rigid multibody systems for large space structures and some results of computer simulation
[NAL-TR-942] N88-17730
LASER APPLICATIONS
Laser investigations for payload G-652 prior to filing pre-flight accommodation requirements N88-17694
High resolution electron and ion microscopy
[AERE-R-12502] N88-17754
A ring model of the lasertron
[DE88-004656] N88-17908
Digital imaging techniques for single- and multi-phase reacting flowfields N88-17933
Monitoring interfacial dynamics by pulsed laser techniques
[DE88-003362] N88-17976
Overview of applications of Laser-Induced Breakdown Spectroscopy (LIBS)
[DE88-004314] N88-17987
Optically controlled devices and ultrafast laser sources for signal processing
[AD-A187417] N88-17995
Evaluation of a temperature remote sensing technique
[AD-A187885] N88-18053
LASER DOPPLER VELOCIMETERS
Investigation of dynamic stall using LDV (Laser Doppler Velocimetry): Mean flow studies
[AD-A187629] N88-17611
LASER FUSION
High Z interaction physics on Nova
[DE88-004397] N88-18433
LASER MATERIALS
A nuclear structure study of the proposed gamma-ray laser candidate nucleus Re-186
[DE88-004299] N88-17986
LASER OUTPUTS
Spatially resolved X-ray laser spectra and demonstration of gain in nickel-like systems
[DE88-003957] N88-17979
Dynamics of coupled electron-nucleon motion in a laser field
[DE88-005063] N88-17994

Evaluation of a temperature remote sensing technique [AD-A187885] N88-18053
LASER PLASMAS
Spatially resolved X-ray laser spectra and demonstration of gain in nickel-like systems [DE88-003957] N88-17979
Overview of applications of Laser-Induced Breakdown Spectroscopy (LIBS) [DE88-004314] N88-17967
LASER PROPULSION
Advanced energy conversion concept for beamed-energy propulsion [AD-A187336] N88-17914
LASER SPECTROSCOPY
Energy transfer studies with lasers [DE88-004864] N88-17991
Two-photon (VUV and visible) resonant ionization spectroscopy of atoms and molecules [DE88-004332] N88-18366
LASER WEAPONS
Where directed energy stands in strategic defense [DE88-005092] N88-18365
LASERS
Bright source lasers and experiments at very high irradiance [DE88-004317] N88-17988
Laser studies of the dynamics of free radical reactions [DE88-004431] N88-17989
Absolute rate measurements of two-photon process of gases, liquids, and solids [DE88-003800] N88-18391
Investigations of stimulated Raman scattering from high density underdense plasmas irradiated by a 0.35 micron laser N88-18421
LATERAL CONTROL
Determination of the drag of missiles with variable lateral acceleration possibility [REPT-FM15] N88-17831
LATERAL STABILITY
Investigation of dihedral effects in compressor cascades N88-17672
LATTICE VIBRATIONS
The convergence rate for the strong law of large numbers: General lattice distributions [AD-A187560] N88-18362
Order-disorder transition of Au and Pt (110) surfaces: The significance of relaxations and vibrations [DE88-004651] N88-18473
LAYOUTS
Aerodynamic aspects of the configurational systems layout of a dispenser [MBB-UA-1047/87] N88-17863
LEAD ACID BATTERIES
Laboratory evaluation and analysis of advanced lead-acid load-leveling batteries [DE88-002851] N88-18064
LEADERSHIP
Networking requirements and future alternatives [NASA-TM-89711] N88-18517
LEADING EDGES
On the effect of leading edge blowing on circulation control airfoil aerodynamics N88-17595
LEAKAGE
One-dimensional leakage-flow vibration instabilities [DE88-002875] N88-17947
LEARNING
Analysis and synthesis of adaptive neural elements [AD-A187047] N88-18316
LEARNING THEORY
Knowledge base refinement by monitoring abstract control knowledge, revision 1 [AD-A187502] N88-18323
LEG (ANATOMY)
Morphological manifestations of primate adaptation to orthograde statics and walking erect N88-18162
LIBRARIES
Hierachical object recognition using libraries of parameterized model sub-parts [AD-A187476] N88-18322
LIE GROUPS
Applications of Lie group methods to the equations of magnetohydrodynamics N88-18422
LIFE (DURABILITY)
Mechanics of composite materials: Past, present and future [NASA-TM-100793] N88-17744
LIFE CYCLE COSTS
STS propellant scavenging systems study. Part 2, volume 2: Cost and WBS/dictionary [NASA-CR-179276] N88-17717
Future directions in computer architecture N88-18257
LIFE SCIENCES
System analysis study of space platform and station accommodations for life sciences research facilities. Volume 1: Executive summary. Phase A: Conceptual design and programmatics [NASA-CR-179268] N88-17721
System analysis study of space platform and station accommodations for life sciences research facilities. Volume 2: Study results, attachment 2. Phase A: Conceptual design and programmatics [NASA-CR-179272] N88-17722
System analysis study of space platform and station accommodations for life sciences research facilities. Volume 2: Study results. Appendix E: Work breakdown structure and dictionary [NASA-CR-179274] N88-17723
System analysis study of space platform and station accommodations for life sciences research facilities. Volume 2: Study results. Appendix D: Life sciences research facility requirements [NASA-CR-179273] N88-17724
USSR Space Life Sciences Digest, issue 15 [NASA-CR-3922(18)] N88-18175
Minutes of the meeting of the Indo-US Subcommission on Science and Technology (8th) held at Washington, D.C. on September 22-24, 1986 [PB88-130158] N88-18503
LIFE SPAN
Drosophila geotaxis as a tool for the study of aging N88-17706
LIFT
Wind tunnel studies of circulation control elliptical airfoils N88-17598
Lifting-surface theory of oscillating propellers in compressible flow [NAL-TR-943] N88-17613
LIFT AUGMENTATION
Evaluation of a research circulation control airfoil using Navier-Stokes methods N88-17591
On the effect of leading edge blowing on circulation control airfoil aerodynamics N88-17595
The impact of circulation control on rotary aircraft controls systems N88-17601
Analysis of a fixed-pitch X-wing rotor employing lower surface blowing N88-17602
An aerodynamic comparison of blown and mechanical high lift airfoils N88-17606
Fixed wing CCW aerodynamics with and without supplementary thrust deflection N88-17607
Circulation control STOL aircraft design aspects N88-17610
LIGHT AIRCRAFT
Modern materials for light constructions — aircraft [MBB-Z-136/86] N88-17839
LIGHT SCATTERING
Digital imaging techniques for single- and multi-phase reacting flowfields N88-17933
Advances in calculating macroionic solution structure [DE88-003799] N88-18406
LIGHT SOURCES
Signal processing studies program optical signal amplification, volume 2 [AD-A188054] N88-17896
LIGHT TRANSMISSION
Signal processing for an optical wide band data transmission system [DE88-003854] N88-17888
LIMITERS (FUSION REACTORS)
Stability of an RFP (Reversed-Field Pinch) with resistive and distant boundaries [DE88-004155] N88-18431
LINE SPECTRA
Gamma-ray imaging observations of the Crab and Cygnus regions N88-18522
An analysis of longitude variations in the equatorial spectrum of Saturn N88-18539
LINEAR ACCELERATORS
Preliminary injector, accelerator, and beamline design for rf-linac-driven XUV free-electron lasers [DE88-003185] N88-17983
LINEAR EQUATIONS
PSolve: A concurrent algorithm for solving sparse systems of linear equations [DE88-003584] N88-18275
Quasigroup approach to solution of linear algebraic equation systems [DE88-700595] N88-18330
Leapfrog variants of iterative methods for linear algebra equations [NASA-CR-181616] N88-18332
Schwarz splitting and template operators [AD-A187956] N88-18370
LINEAR PROGRAMMING
The impact of hierarchical memory systems on linear algebra algorithm design [DE88-003574] N88-18274
Eliminating columns in the simplex method for linear programming [DE88-004191] N88-18277
Performance studies of a parallel processor for large linear programming problems [PB88-121611] N88-18310
LINEAR SYSTEMS
Dynamic observers as asymptotic limits of recursive filters: Special cases [AD-A187578] N88-18324
Linear prediction of stationary vector sequences [NASA-TM-100069] N88-18366
LINEARITY
Application of empirical and linear methods to VSTOL powered-lift aerodynamics [NASA-TM-100048] N88-17581
Parametric study of choke flutter with a linear theory N88-17673
LINGUISTICS
Quantitative and qualitative assessments of the impact of linguistic theory on information science N88-18507
LIPIDS
Lipid peroxidation in rat tissues with exposure to antiorthostatic hypokinesia, exercise and immobilization stress N88-18159
LIQUID ATOMIZATION
Droplet formation for liquid monopropellant jets [AD-A187172] N88-17956
LIQUID FUELS
Droplet formation for liquid monopropellant jets [AD-A187172] N88-17956
LIQUID HELIUM
Study of helium transfer technology for STICCR: Fluid management [NASA-CR-177463] N88-17720
LIQUID ROCKET PROPELLANTS
An infra-red investigation of HAN (Hydroxylammonium Nitrate)-based liquid propellants [AD-A187226] N88-17815
LIQUID SLOSHING
Spatial pressure variations and three-dimensional effects on liquid sloshing loads [PB88-120134] N88-17926
LIQUID-SOLID INTERFACES
An advanced microcomputer design for processing of semiconductor materials N88-17703
LIQUID-VAPOR INTERFACES
Investigation of real-time two-dimensional visualization of fuel spray liquid/vapor distribution via exciplex fluorescence [AD-A188268] N88-17816
LISP (PROGRAMMING LANGUAGE)
A rule-based Lisp dialect translator using paramodulation N88-18238
LITHIUM
Environment assisted degradation mechanisms in aluminum-lithium alloys [NASA-CR-182482] N88-17782
LITHOLOGY
Geological evolution and analysis of confirmed or suspected gas hydrate localities. Volume 10: Basin analysis, formation and stability of gas hydrates of the Aleutian Trench and the Bering Sea [DE88-001008] N88-18048
Geological evolution and analysis of confirmed or suspected gas hydrate localities. Volume 9: Formation and stability of gas hydrates of the Middle America Trench [DE88-001007] N88-18050
Data-base of Antarctic pre-Pleistocene sediment cores [PB88-124151] N88-18094
LIVER
Effect of weightlessness on replicative function of rat hepatocyte DNA N88-18129
RNA-synthesizing activity in rat liver following flight aboard Cosmos-1667 N88-18130
LOADS (FORCES)
A research program on the aerodynamics of a highly loaded turbine stage N88-17655
Tactile sensing and inverse problems [AD-A187464] N88-18011
LOCAL AREA NETWORKS
The design of load balancing strategies for distributed systems N88-18216
Experiments with parallel program execution on a network of workstations N88-18217
An Ethernet local area network controller with supporting operating system software [DE88-003534] N88-18304
LOGIC CIRCUITS
Signal processing studies program VLSI designs for unary functions [AD-A188053] N88-17922

LOGIC DESIGN
A framework for evaluating computer architectures to support systems with security requirements, with applications
[AD-A187082] N88-18303
LOGIC PROGRAMMING
An investigation of parallelism in rule based systems N88-18223
Experimenting with parallel programing in logic N88-18240
Parallel architectures for logic programming N88-18241
Implementing logical variables on a graph reduction architecture N88-18252
Deriving abstractions from a software object network
[AD-A187472] N88-18294
LONG DURATION SPACE FLIGHT
Analysis of water recovered after being used for washing by men and women N88-18135
Present stage of space medicine N88-18151
Effect of spaceflight factors on biological material flown aboard Cosmos-1514 biosatellite N88-18154
Basic results of medical studies during prolonged manned flights on-board the Salyut-7/Soyuz-T orbital complex
[NASA-TT-20217] N88-18182
LONG TERM EFFECTS
Short- and long-term effects of nonlethal levels of fast high-energy helium ions on retention of developed and formation of new behavioral patterns in rats N88-18140
Results of long-term electrocardiographic monitoring of cosmonauts N88-18152
LONG WAVE RADIATION
Application of satellite data in observational and theoretical studies of the evolving structure of baroclinic waves
[NASA-CR-179277] N88-18091
LONGITUDINAL WAVES
An analysis of longitude variations in the equatorial spectrum of Saturn N88-18539
LOOPS
Performance evaluation of a loop interconnection structure N88-18229
Loop coalescing: A compiler transformation for parallel machines
[DE88-003571] N88-18307
Deadlock prevention in processor self-scheduling for parallel nested loops
[DE88-003573] N88-18313
LOW ASPECT RATIO
Periodic natural convection in a rectangular enclosure of low aspect ratio N88-17941
LOW COST
Lightsats and their attraction to budget oriented Federal agencies N88-17711
LOW TEMPERATURE
Effect of low-temperature aging on the mechanical properties of cast stainless steels
[DE88-002872] N88-17774
LOW TEMPERATURE ENVIRONMENTS
Polar worker adaptability to Antarctic high altitudes N88-18165
LUBRICANTS
An evaluation of effectiveness of PTFE (polytetrafluoroethylene) type friction reducers on reducing friction and wear
[AD-A187440] N88-18010
LUNGS
Effect of exogenous cardiosynchronized counterpulsation on human regional and central hemodynamics N88-18163
LUTETIUM COMPOUNDS
Electrochromic cells with lutetium diphthalocyanine and semisolid polymer electrolytes
[AD-A188031] N88-18078

M

MACHINING
The mechanism of anisotropic silicon etching and its relevance for micromachinings
[MCB-UA-1013/86] N88-17838
MAGNESIUM OXIDES
Brittle to ductile transition to cleavage fracture
[DE88-004074] N88-18481
MAGNET COILS
Plasma physics design and major specifications of candidate reactors for FER design studies. Conceptual design study of FY86 FER
[DE88-751066] N88-18416
MAGNETIC CONTROL
Magnetic control of low pressure discharges
[AD-A186794] N88-17900
MAGNETIC DISPERSION
Time-domain reciprocity theorems for electromagnetic fields in dispersive media
[PB88-126925] N88-17886
MAGNETIC FIELD CONFIGURATIONS
D-3He fuels in a field-reversed configuration
[IPPJ-855] N88-18419
Applications of Lie group methods to the equations of magnetohydrodynamics N88-18422
Evaluation of magnetic coordinates in finite-beta, asymmetric plasmas
[DE88-003665] N88-18424
MAGNETIC FIELDS
Realistic conductivity geometry model of the human head for interpretation of neuromagnetic data
[PB88-112230] N88-18179
Evaluation of magnetic coordinates in finite-beta, asymmetric plasmas
[DE88-003665] N88-18424
The relation of solar wind structure to hydromagnetic discontinuities
[DE88-004304] N88-18546
MAGNETIC FLUX
Magnetic emissions testing of the space station engineering model resistojet
[NASA-TM-100788] N88-17728
Magnetic control of low pressure discharges
[AD-A186794] N88-17900
MAGNETIC LEVITATION VEHICLES
The MBB propulsion concepts for magnetic suspension railways: Retrospective view and prospects
[MBB-Z-141/87] N88-17865
MAGNETIC MATERIALS
CdTe(110)-Mn interface reaction and the formation of non-equilibrium ternary semimagnetic semiconductor alloys
[AD-A187593] N88-18491
MAGNETIC MOMENTS
High temperature processing of superconducting Y1Ba2Cu3O6.9
[DE88-003002] N88-18449
Neutrino magnetic moment and time variation of solar neutrino flux
[DE88-700687] N88-18542
MAGNETIC PERMEABILITY
The effect of magnetic impurities and barriers on the magnetization and critical current of fine filament NbTi composites
[DE88-004443] N88-18472
MAGNETIC PROPERTIES
Superconducting and magnetic properties of Fe-doped oxide superconductors
[DE88-003024] N88-18451
The physics of metallic superlattices: An experimental point of view
[DE88-003080] N88-18452
Magnetic rare earth superlattices
[DE88-003483] N88-18465
MAGNETIZATION
Improved magnetization for YBa2Cu3O/sub 7-delta annealed in oxygen above 1000 C
[DE88-003934] N88-18469
The effect of magnetic impurities and barriers on the magnetization and critical current of fine filament NbTi composites
[DE88-004443] N88-18472
MAGNETOACOUSTICS
The measurement of stress in steels of varying microstructure by Barkhausen and magneto-acoustic emission
[AERE-R-12387] N88-18027
MAGNETOHYDRODYNAMIC FLOW
A study of single and binary ion plasma expansion into laboratory-generated plasma wakes
[NASA-CR-4125] N88-18427
MAGNETOHYDRODYNAMIC GENERATORS
Laser production and heating of plasma for MHD application
[NASA-TP-2798] N88-18443
MAGNETOHYDRODYNAMIC STABILITY
Tokamak with highly elongated cross-section of a plasma
[DE88-700356] N88-18412
Plasma confinement calculations for TIBER-2
[DE88-004044] N88-18425
Stability of an RFP (Reversed-Field Pinch) with resistive and distant boundaries
[DE88-004155] N88-18431
The stability of free-electron lasers against filamentation
[DE88-004712] N88-18435
MAGNETOHYDRODYNAMIC TURBULENCE
Coronal heating by means of helical magnetohydrodynamic turbulence
[AD-A187084] N88-18413
Study of resistive pressure-gradient-driven turbulence
[DE88-005062] N88-18441
MAGNETOHYDRODYNAMICS
Applications of Lie group methods to the equations of magnetohydrodynamics N88-18422
Self-similar solutions of MHD equations of plasma filament in the case of complete degenerated ultrarelativistic electron gas
[DE88-700684] N88-18426
The relation of solar wind structure to hydromagnetic discontinuities
[DE88-004304] N88-18546
MAGNETOPAUSE
A study of the magnetic field annihilation process in the magnetosphere and some geotechnical applications
[DE88-004165] N88-18096
MAGNETORESISTIVITY
Spin disorder resistivity and bare Curie temperature in the ferromagnetic superconductor ErRh4B4
[DE88-003016] N88-18445
Normal and superconducting state properties of La2-xSr/sub x/CuO4
[DE88-003013] N88-18450
MAMMALS
Physiological and ecological implications of coupled heat- and water-transport mechanisms of endotherms and vegetation
[DE88-004170] N88-18081
MAN MACHINE SYSTEMS
Crew interface with windshear systems N88-17631
Medical and psychological problems of assuring flight safety under present conditions N88-18123
MAN-COMPUTER INTERFACE
Methods of eliciting information from experts
[AD-A187488] N88-18189
MANAGEMENT METHODS
Operations research in management?
[MBB-Z-138/87] N88-17835
Using SIR (Scientific Information Retrival) system for data management during a field program
[DE88-001555] N88-18508
MANAGEMENT SYSTEMS
Using SIR (Scientific Information Retrival) system for data management during a field program
[DE88-001555] N88-18508
MANEUVERABILITY
Future fighter maneuverability for air combat
[MBB/LKE-1/S/PUB/120] N88-17843
On the maneuvering of vehicles
[AD-A187632] N88-18521
MANEUVERABLE REENTRY BODIES
Maneuverable reentry vehicle trajectory footprints: Calculation and properties
[DE88-004726] N88-17726
MANGANESE
CdTe(110)-Mn interface reaction and the formation of non-equilibrium ternary semimagnetic semiconductor alloys
[AD-A187593] N88-18491
MANGANESE ALLOYS
Influence of non-metallic elements in the mechanical properties of 20 Mn Mo Ni 55 steel
[DE88-700412] N88-17775
Response of Fe-Cr-Mn austenitic alloys to thermal aging neutron irradiation
[DE88-003415] N88-17785
The role of composition and microstructure gradients on weld metal properties and behavior
[DE88-004956] N88-17791
MANIPULATORS
Design conditions and workspace for the generally-proportioned 3-hinge spherical wrist for robots N88-18003
Recursive forward dynamics for multiple robot arms moving a common task object
[NASA-CR-182526] N88-18008
Tactile sensing and inverse problems
[AD-A187484] N88-18011
Parameter identification and sensitivity analysis for a robotic manipulator arm
[NASA-CR-181608] N88-18272
MANNED SPACE FLIGHT
Study on long term evolution towards European manned space flight. Volume 1: Executive summary
[MBB-RA3-004/87-VOL-1] N88-17689
Present stage of space medicine N88-18151
Certain aspects of human metabolism during spaceflights of varying duration
[NASA-TT-20215] N88-18181
Basic results of medical studies during prolonged manned flights on-board the Salyut-7/Soyuz-T orbital complex
[NASA-TT-20217] N88-18182

MANUFACTURING
Automated Composites, First International Conference, September 10-12, 1988, University of Nottingham, England
[PB87-126199] N88-17734
Ion chromatography in the manufacture of multilayer circuit boards
[DE88-002428] N88-17902

MAPPING
A smart, mapping, charting and geodesy control generator, phase 1
[AD-A188184] N88-18055
An overview of the transactional interpretation of quantum mechanics
[DE88-004236] N88-18497

MARINE METEOROLOGY
US Navy climatic study of the Mediterranean Sea
[AD-A188264] N88-18107

MARINE TECHNOLOGY
MTI-Interface (Moving Target Indication-Interface) for simple radar
[PB88-126578] N88-17984
Analysis of wind turbines on offshore support structures excited by random wind and random waves
[DE88-004772] N88-18074

MARITIME SATELLITES
NROSS (Navy Remote Ocean Sensing System): A force multiplier
[AD-A186853] N88-18045

MARKOV PROCESSES
A queueing system with independent Markov input streams
[AD-A187601] N88-18363

MARS
Interplanetary mission design handbook. Volume 1, Part 5: Mars-to-Earth ballistic mission opportunities, 1992-2007
[NASA-CR-182525] N88-18538

MARS SURFACE
Gamma-ray and neutron spectroscopy of planetary surfaces and atmospheres
[DE88-004287] N88-18541

MASERS
Physics modeling support contract
[DE88-004039] N88-17980

MASS DISTRIBUTION
On the time delay of the ultrahigh-energy radiation signal from the source Cygnus X-3
[DE88-700649] N88-18547

MASS SPECTRA
Trace analysis by MS/MS on a double focussing mass spectrometer
[AD-A187954] N88-17973

MASS SPECTROMETERS
Trace analysis by MS/MS on a double focussing mass spectrometer
[AD-A187954] N88-17973

MASS SPECTROSCOPY
A chemical precursor to optical damage. Studies by laser ionization mass spectrometry
[DE88-004321] N88-18408

MASS TRANSFER
Application of Hoffman modulation contrast microscopy coupled with three-wavelength two-beam interferometry to the in situ direct observation of the growth process of a crystal in microgravity N88-17704
Experimental studies of heat and mass exchange in parallel-passage rotary desiccant dehumidifiers for solar cooling applications
[DE88-001119] N88-18069
Physiological and ecological implications of coupled heat- and water-transport mechanisms of endotherms and vegetation
[DE88-004170] N88-18081

MATERIALS HANDLING
Non-proprietary research projects of the Center for the Space Processing of Engineering Materials
[AR-2] N88-18516

MATERIALS RECOVERY
STS propellant scavenging systems study. Part 2, volume 1: Executive summary and study results
[NASA-CR-179275] N88-17716
Evaluation of bituminous materials used in pavement recycling projects at Tyndall, MacDill, and Hurlburt Air Force Bases
[AD-A188068] N88-17871

MATHEMATICAL LOGIC
The implementation of artificial intelligence in control systems
[DE88-003497] N88-18318
The representation of knowledge within model-based control systems
[DE88-004863] N88-18319

MATHEMATICAL MODELS
Navier-Stokes calculations and turbulence modeling in the trailing edge region of a circulation control airfoil N88-17587
Wall jet analysis for circulation control aerodynamics. Part 1: Fundamental CFD and turbulence modeling concepts N88-17588
A theory for turbulent curved wall jets N88-17590
Wall jet analysis for circulation control aerodynamics. Part 2: Zonal modeling concepts for wall jet/potential flow coupling N88-17593
Frequency-response identification of XV-15 tilt-rotor aircraft dynamics N88-17643
Maneuverable reentry vehicle trajectory footprints: Calculation and properties
[DE88-004726] N88-17726
Insights into the mechanisms of chemical reactions: Reaction paths for chemical reactions
[DE88-003041] N88-17755
Gas hydrate model development and validation
[DE88-001004] N88-17762
A large strain thermomechanical forming model for elastic-viscoplastic behavior in metals N88-17780
The mathematization of the military sciences
[MBB-Z-139/87] N88-17834
Radar reflectivity and attenuation of radio waves in the melting layer of precipitation
[PB88-121553] N88-17882
Pulsed current transformer for low inductive loads
[AD-A187224] N88-17913
Leeside crossflow modeling in Euler space-marching computations
[NASA-TM-89710] N88-17924
Centerplane source distribution for slender bodies N88-17940
Periodic natural convection in a rectangular enclosure of low aspect ratio N88-17941
Three-dimensional incompressible flowfield analysis for establishing rotor designs which optimize power extraction N88-17943
A review of flow-induced vibration in two-phase flow
[DE88-002873] N88-17946
Capacitive charge division in centroid finding cathode readouts in MWPCs
[DE88-003545] N88-17969
Physics modeling support contract
[DE88-004039] N88-17980
Analysis and application of the constant tensile load test for polyethylene gas pipe materials
[DE88-002868] N88-18037
Turbulence loads on the Howden 26-m-diameter wind turbine
[TI88-001118] N88-18075
Evaluation of regional-scale air quality models: Chairmen reports from four workshops
[DE88-001397] N88-18080
Simulation and modeling of whistler mode wave growth through cyclotron resonance with energetic electrons in the magnetosphere N88-18089
Analysis of gases in the earth's crust
[PB88-141619] N88-18093
Systematic errors of the FSU global spectral model N88-18103
Membrane model of cupula or vestibular semicircular canals N88-18132
Two-dimensional static otolith model N88-18167
Scaling physiological pharmacokinetic models by physiological time
[DE88-000335] N88-18173
Modeling of the non-auditory response to blast overpressure
[AD-A187397] N88-18184
Parameter identification and sensitivity analysis for a robotic manipulator arm
[NASA-CR-181606] N88-18272
Identifiability of multivariate ARMA models
[AD-A187394] N88-18350
Well-posedness and spectral estimation for infinite dimensional systems
[AD-A187621] N88-18354
A component synthesis method using Lanczos vectors
[DE88-002263] N88-18368
Applied mathematics of transport theory
[DE88-004098] N88-18369
Semiempirical studies of atomic structure
[DE88-004096] N88-18392
Advances in calculating macroionic solution structure
[DE88-003799] N88-18406
Coronal heating by means of helical magnetohydrodynamic turbulence
[AD-A187084] N88-18413
Positron-annihilation 2D-ACAR studies of disordered and defected alloys
[DE88-003118] N88-18454

MATHEMATICS
Interdisciplinary research in mathematics, science and technology education
[PB88-131446] N88-18333

MATRICES (MATHEMATICS)
An applicative programmer's approach to matrix algebra, lessons for hardware and software N88-18251
A multigrid preconditioner applied to a two-dimensional convection-diffusion problem
[DE88-004765] N88-18329
Identifiability of multivariate ARMA models
[AD-A187394] N88-18350
Status of the electroweak theory
[DE88-002342] N88-18494

MATRIX METHODS
An efficient sparse matrix multiplication scheme for the CYBER 205 computer
[NASA-TM-4028] N88-18302

MATTER (PHYSICS)
The origin of the diffuse X-ray background and the formation of galaxies and voids N88-18527
Quark matter in astrophysics and cosmology
[DE88-003406] N88-18534

MEASURE AND INTEGRATION
The precision of limits on bodily fluids when using beta-expectation inner tolerance limits
[AD-A187966] N88-18185

MEASURING INSTRUMENTS
A technique for low level, wide range CW microwave power meter calibrations
[DE88-004147] N88-17966
Into the thermosphere: The atmosphere explorers
[NASA-SP-490] N88-18084
Developments in National Weather Service meteorological data collection programs as related to EPA (Environmetal Protection Agency) air pollution models
[PB88-130240] N88-18104

MECHANICAL DEVICES
Tactile sensing and inverse problems
[AD-A187464] N88-18011

MECHANICAL DRIVES
Analysis of possible transmission arrangements applicable for driving single or twin counterrotating fans on propfan engines N88-17670

MECHANICAL PROPERTIES
Effect of post-cure heat-treatment on static and fatigue behaviour of XAS-914C carbon fibre composite
[AD-A186943] N88-17735
Effects of aviation fluids on carbon fibre composite material
[PB88-127857] N88-17740
Mechanics of composite materials: Past, present and future
[NASA-TM-100793] N88-17744
Influence of non-metallic elements in the mechanical properties of 20 Mn Mo Ni 55 steel
[DE88-700412] N88-17775
Effects of the neutron spectrum on mechanical property changes in low dose irradiations
[DE88-003429] N88-17786
The role of composition and microstructure gradients on weld metal properties and behavior
[DE88-004956] N88-17791
Bias, internal stress and substrate effects on the microstructure and properties of PVD-wear resistant coatings
[AERE-R-12360] N88-17798
Adhesion, friction and micromechanical properties of ceramics
[NASA-TM-100782] N88-17801
Mechanisms of wear in single- and two-phase materials
[DE88-003648] N88-17806
Physical and structural characteristics of Weddell Sea pack ice
[AD-A188189] N88-18119

MECHANICAL SHOCK
The Shock and Vibration Digest, volume 20, no. 2 N88-18459

MEDITERRANEAN SEA
US Navy climatic study of the Mediterranean Sea
[AD-A188264] N88-18107

MELTING
Results from the melting of tungsten composites under microgravity (Texus 10 flight)
[PB88-128236] N88-17817
Radar reflectivity and attenuation of radio waves in the melting layer of precipitation
[PB88-121553] N88-17882

MEMBRANE STRUCTURES
Optimization of the southern electrophoretic transfer method
[DE88-004527] N88-17765

MEMBRANES
Photochemical solar energy conversion utilizing semiconductors localized in membrane mimetic systems
[DE88-002887] N88-18065
MEMORY (COMPUTERS)
Research and development trends for memory hierarchies — cache memories N88-18198
Vector performance of register-to-register vector computers
[DE88-004013] N88-18265
The impact of hierarchical memory systems on linear algebra algorithm design
[DE88-003574] N88-18274
Debugging FORTRAN on a shared memory machine
[DE88-003589] N88-18276
Using program structure to achieve prefetching for cache memories
[DE88-003599] N88-18282
The performance of software-managed multiprocessor caches on parallel numerical programs
[DE88-003590] N88-18308
Data prefetching in shared memory multiprocessors
[DE88-003576] N88-18314
MENTAL PERFORMANCE
Cardiovascular and subjective measures of task demand in a low workload monitoring task
[REPT-8804] N88-18176
MERCURY CADMIUM TELLURIDES
Ytterbium monolayer diffusion barriers at Hg(1-x)Cd(x)Te/Al junctions
[AD-A188013] N88-17768
MBE growth, characterization and electronic device processing of HgCdTe, HgZnTe related heterojunctions and HgCdTe-CdTe superlattices
[AD-A187456] N88-18486
Local stoichiometry and atomic interdiffusion during reactive metal/mercury-cadmium-telluride junction formation
[AD-A187554] N88-18488
Nonmonotonic evolution and thermodynamic trends at metal/(Hg,Cd)Te interfaces: Yb/Hg0.78Cd0.22Te
[AD-A187591] N88-18490
MESOSCALE PHENOMENA
Analysis of quasi-geostrophic forcing during the AIMCS (Airborne Investigations of Mesoscale Convective Systems) Project. Volume 2: Results for June 14 through July 16, 1984
[PB88-123807] N88-18092
MESSAGE PROCESSING
Optical symbolic processor for expert system execution
[AD-A187494] N88-18268
METABOLISM
Human blood glutamic acid level with exposure to high ambient concentrations of ammonia N88-18134
New book on metabolic aspects of spaceflight stress N88-18172
Certain aspects of human metabolism during spaceflights of varying duration
[NASA-TT-20215] N88-18181
METAL FATIGUE
Fatigue crack growth due to random loading
[DE88-004641] N88-18038
METAL FILMS
Optical measurements of surface oxide layer formation on metal films
[DE88-003163] N88-18405
METAL FOILS
High-temperature properties of ceramic fibers and insulations for thermal protection of atmospheric entry and hypersonic cruise vehicles
[NASA-TM-100059] N88-17743
METAL HYDRIDES
Metal hydrides
[DE88-005083] N88-17766
Chemical activation of molecules by metals: Experimental studies of electron distributions and bonding
[DE88-004465] N88-18393
METAL MATRIX COMPOSITES
Micro-mechanisms of deformation in SiC/Al composites
[AD-A188282] N88-17749
Results from the melting of tungsten composites under microgravity (Texus 10 flight)
[PB88-128236] N88-17817
METAL OXIDE SEMICONDUCTORS
Formal multilevel hierarchical verification of synchronous MOS VLSI circuits
[AD-A187532] N88-17918
METAL OXIDES
Effect of the gate oxide thickness on the speed of MOS integrated circuits
[PB88-155783] N88-17910
METAL PARTICLES
Characterization of the arc/spark excitation sources used in the spectrometric oil analysis program
[AD-A187131] N88-17758
Results from the melting of tungsten composites under microgravity (Texus 10 flight)
[PB88-128236] N88-17817
METAL PLATES
A detailed microstructural examination of the cause of HAZ cracking in type 316 steel
[AERE-R-12428] N88-17777
Effects of commercial cladding on the fracture behavior of pressure vessel steel plates
[DE88-004333] N88-17790
METAL SURFACES
Local stoichiometry and atomic interdiffusion during reactive metal/mercury-cadmium-telluride junction formation
[AD-A187554] N88-18488
METAL VAPORS
The band systems of alkali vapors
[NASA-TT-20206] N88-18462
METAL-METAL BONDING
New scientific findings on the morphology of aluminum oxide layers, serving as an adhesive basis
[MBB-Z-137/86] N88-17840
METALLIZING
Microscopic control of metallization stability
[AD-A187553] N88-18487
METALLOGRAPHY
A detailed microstructural examination of the cause of HAZ cracking in type 316 steel
[AERE-R-12428] N88-17777
METALS
A large strain thermomechanical forming model for elastic-viscoplastic behavior in metals N88-17780
Irradiation effects in metals
[DE88-004272] N88-17789
Metal modification for improved glass-ceramic to metal seals: 1. Auger results on ion implantation and vapor deposition films
[DE88-005244] N88-18006
Chemical activation of molecules by metals: Experimental studies of electron distributions and bonding
[DE88-004465] N88-18393
Non-proprietary research projects of the Center for the Space Processing of Engineering Materials
[AR-2] N88-18516
METEOROID PROTECTION
Space station integrated wall damage and penetration damage control. Task 5: Space debris measurement, mapping and characterization system
[NASA-CR-179281] N88-17688
An analysis of penetration and ricochet phenomena in oblique hypervelocity impact
[NASA-TM-100319] N88-18004
METEOROLOGICAL PARAMETERS
NASA Oceanic Processes Program
[NASA-TM-4025] N88-18109
METEOROLOGICAL RADAR
Airborne Doppler radar technology for wind shear detection N88-17622
Status of FAA terminal Doppler weather radar programs N88-17632
Information transfer in the National Airspace System N88-17634
METEOROLOGY
NASA wind shear model: Summary of model analyses N88-17617
Cape Blanco wind farm feasibility study
[DE88-003748] N88-18059
Wake effects in a Fayette 95-IIS wind turbine array
[DE88-001103] N88-18063
The structure and dynamics of monsoon depressions N88-18102
Developments in National Weather Service meteorological data collection programs as related to EPA (Environmetal Protection Agency) air pollution models
[PB88-130240] N88-18104
METHANE
Gas hydrate model development and validation
[DE88-001004] N88-17762
Geological evolution and analysis of confirmed or suspected gas hydrate localities. Volume 9: Formation and stability of gas hydrates of the Middle America Trench
[DE88-001007] N88-18050
METHYL ALCOHOL
Fuel cell/battery hybrid vehicle assessment
[DE88-005087] N88-18520
MICE
Scaling physiological pharmacokinetic models by physiological time
[DE88-000335] N88-18173
MICHELSON INTERFEROMETERS
Modern pulsed wavemeters
[DE88-003875] N88-17978
MICROCHANNEL PLATES
Performance of a photon counting microchannel plate intensifier with wedge and strip image readout
[DE88-003831] N88-17970
MICROCOMPUTERS
An advanced microcomputer design for processing of semiconductor materials N88-17703
Microcomputer analysis of regenerative heat exchangers for oscillating flow
[DE88-001773] N88-17945
Parallelism at the microlevel: Cooperative microcontrollers with real time considerations N88-18246
MICROMECHANICS
A fiber-resin micromechanics analysis of the delamination front in a DCB specimen
[NASA-TM-100540] N88-17737
Mechanics of composite materials: Past, present and future
[NASA-TM-100793] N88-17744
Adhesion, friction and micromechanical properties of ceramics
[NASA-TM-100782] N88-17801
The mechanism of anisotropic silicon etching and its relevance for micromachinings
[MBB-UA-1013/86] N88-17838
MICROPROCESSORS
Microcomputer analysis of regenerative heat exchangers for oscillating flow
[DE88-001773] N88-17945
High-performance CPU implementation of the nebula instruction set architecture N88-18194
The design of ultra high-speed numeric intensive systems (having fault tolerant and load balancing capabilities) N88-18196
Hardware implementation for special functions. An application for combat simulation N88-18197
MICRO system for control, acquisition and processing of experimental data
[DE88-700724] N88-18278
Implementation of encoders and decoders for Reed-Solomon codes
[PB88-126628] N88-18286
MICROSTRUCTURE
Micro-mechanisms of deformation in SiC/Al composites
[AD-A188282] N88-17749
A detailed microstructural examination of the cause of HAZ cracking in type 316 steel
[AERE-R-12428] N88-17777
Influence of convection on microstructure
[NASA-CR-182489] N88-17784
Response of Fe-Cr-Mn austenitic alloys to thermal aging neutron irradiation
[DE88-003415] N88-17785
Irradiation effects in metals
[DE88-004272] N88-17789
The role of composition and microstructure gradients on weld metal properties and behavior
[DE88-004956] N88-17791
Bias, internal stress and substrate effects on the microstructure and properties of PVD-wear resistant coatings
[AERE-R-12360] N88-17798
Mechanisms of wear in single- and two-phase materials
[DE88-003846] N88-17806
Durability and damage tolerance of aluminum castings
[AD-A186444] N88-18013
Acoustic emission-microstructural relations in ferritic steels. Part 3: The effect of inclusion content
[AERE-R-12041] N88-18015
The measurement of stress in steels of varying microstructure by Barkhausen and magneto-acoustic emission
[AERE-R-12387] N88-18027
Relationship between fatigue life in the creep-fatigue region and stress-strain response
[NASA-TM-100796] N88-18040
Optical characterization of GaAs/sub 1-x/Sb/sub x/ and GaAs/sub 1-x/Sb/sub x/GaAs strained layer superlattices
[DE88-003393] N88-18464
The structure and properties of twin boundaries in superconducting YBa2Cu3O7
[DE88-003864] N88-18468
Freestanding films of YBa2Cu3O/sub 6.9/
[DE88-003995] N88-18471
Simulation and processing of high resolution images of defects and interfaces in superconducting YBa2Cu3O7
[DE88-003856] N88-18480

High-resolution X-ray microstructural study of single crystals of YBa2Cu3O/sub 7-y/
[DE88-004856] N88-18484
MICROWAVE AMPLIFIERS
Low-noise cryogenically cooled broad-band microwave preamplifiers
[DE88-004561] N88-17912
MICROWAVE EQUIPMENT
Thermal analysis of transistor packages, part 2
[DE88-005091] N88-17909
MICROWAVES
Fundamental cyclotron frequency generation from a cusptron oscillator
[AD-A188187] N88-17896
A technique for low level, wide range CW microwave power meter calibrations
[DE88-004147] N88-17966
MIGRATION
The migration of grain boundaries in ceramic materials with particular reference to the sintering process
[DE88-004085] N88-17808
MILITARY AIR FACILITIES
Evaluation of bituminous materials used in pavement recycling projects at Tyndall, MacDill, and Hurlburt Air Force Bases
[AD-A188068] N88-17871
MILITARY HELICOPTERS
Helicopter activities in Germany
[MBB-UD-487/86] N88-17853
MILITARY OPERATIONS
The mathematization of the military sciences
[MBB-Z-139/87] N88-17834
Development of a graphics based two-attribute utility assessment program with application to mission planning
[AD-A187276] N88-18292
MILITARY SPACECRAFT
NROSS (Navy Remote Ocean Sensing System): A force multiplier
[AD-A186853] N88-18045
MILITARY TECHNOLOGY
The military techniques of tomorrow. A contribution to active peace assurance
[MBB-UA-1049/87] N88-17860
Optical memory cards: A comparison with other current technologies and potential military applications
[AD-A187287] N88-18512
MINERAL EXPLORATION
Three-dimensional transient electromagnetic modeling for exploration geophysics N88-18047
MINIATURIZATION
TABLET: The personal computer of the year 2000
[NASA-CR-182528] N88-18267
MISSILE CONTROL
POLYPHEM, a universal defensive missile with optical waveguides guidance
[MBB-UA-1045/87] N88-17862
MISSILE DEFENSE
Where directed energy stands in strategic defense
[DE88-005092] N88-18365
MISSILE DESIGN
Determination of the drag of missiles with variable lateral acceleration possibility
[REPT-FM15] N88-17831
Calculation and design of a ramjet missile
[REPT-TR-500] N88-17832
MISSILES
Leeside crossflow modeling in Euler space-marching computations
[NASA-TM-89710] N88-17924
MISSION PLANNING
The 1987 Get Away Special Experimenter's Symposium
[NASA-CP-2500] N88-17691
Planet X probe: A fresh new look at an old familiar place N88-17699
America plans for space
[AD-A187465] N88-17713
Rendezvous and docking verification and demonstration in orbit, executive summary
[MBB-303-16/86] N88-17719
Development of a graphics based two-attribute utility assessment program with application to mission planning
[AD-A187276] N88-18292
Interplanetary mission design handbook. Volume 1, Part 5: Mars-to-Earth ballistic mission opportunities, 1992-2007
[NASA-CR-182525] N88-18538
MIXING
A computational study of thrust augmenting ejectors based on a viscous-inviscid approach N88-17929
MODAL RESPONSE
An adaptive filtering technique for removing periodic noise from modal response data
[DE88-002347] N88-17903
A component synthesis method using Lanczos vectors
[DE88-002263] N88-18368
MODELS
Modeling of some coplanar waveguide discontinuities
[NASA-TM-100808] N88-17880
Improved canopy reflectance modeling and scene inference through improved understanding of scene pattern
[NASA-CR-182488] N88-18049
A paradigm for concurrency control performance evaluation N88-18220
Machine models and simulations
[PB88-118690] N88-18280
Analysis and synthesis of adaptive neural elements
[AD-A187047] N88-18316
Hierachical object recognition using libraries of parameterized model sub-parts
[AD-A187476] N88-18322
Zero-dimensional model of a reversed field pinch fusion reactor
[DE88-005213] N88-18442
MODES
New mode conversion process and overdense plasma heating in the electron cyclotron range of frequencies
[IPPJ-854] N88-18420
MOIRE INTERFEROMETRY
The magic of carrier patterns in moire interferometry
[AD-A187582] N88-17748
The analysis of deformations and strains in composites by moire interferometry
[AD-A187482] N88-18043
MOISTURE
A finite element analysis of adhesively bonded composite joints including geometric nonlinearity, nonlinear viscoelasticity moisture diffusion and delayed failure
[AD-A187455] N88-17747
MOLECULAR BEAM EPITAXY
Microwave semiconductor research-materials, devices and circuits
[AD-A187121] N88-18444
Grazing incidence X-ray scattering study of defect structures in MBE GaAs/Si using synchrotron radiation
[DE88-004556] N88-18483
MBE growth, characterization and electronic device processing of HgCdTe, HgZnTe related heterojunctions and HgCdTe-CdTe superlattices
[AD-A187456] N88-18486
MOLECULAR BEAMS
Apparatus for the study of silicon film deposition and silicon etching
[AD-A187616] N88-17972
Self-pumped phase conjugation in a supersonically flowing medium
[AD-A188281] N88-17998
MOLECULAR CHAINS
Basic research on macromolecular dynamics
[PB88-141643] N88-17805
MOLECULAR INTERACTIONS
Rovibrational spectroscopy of ArCO van der Waals complex
[DE88-004291] N88-18387
MOLECULAR ROTATION
Rovibrational spectroscopy of ArCO van der Waals complex
[DE88-004291] N88-18387
MOLECULAR STRUCTURE
Application of inverse gas chromatography to fluidity studies
[DE88-002896] N88-17750
Investigations on the usefulness of the Massively Parallel Processor for study of electronic properties of atomic and condensed matter systems
[NASA-CR-182514] N88-18259
Energy-related atomic and molecular structure and scattering studies
[DE88-004246] N88-18386
Absolute rate measurements of two-photon process of gases, liquids, and solids
[DE88-003800] N88-18391
MOLTEN SALT ELECTROLYTES
Determination of optimum electrolyte composition for molten carbonate fuel cells literature review
[DE88-001015] N88-18058
MOLYBDENUM ALLOYS
Effect of low-temperature aging on the mechanical properties of cast stainless steels
[DE88-002872] N88-17774
MOMENTUM TRANSFER
Design issues for a laboratory high gain fusion facility
[DE88-004406] N88-18434
Studies in finite time thermodynamics
[DE88-004531] N88-18500
MONITORS
Results of long-term electrocardiographic monitoring of cosmonauts N88-18152
MONKEYS
Effect of spaceflight factors on primate's blood circulation N88-18124
Inflight simian circadian rhythms and temperature homeostasis aboard Cosmos-1514 biosatellite N88-18125
Effect of spaceflight factors on primate hydration homeostasis N88-18126
MONOPROPELLANTS
Droplet formation for liquid monopropellant jets
[AD-A187172] N88-17956
MONSOONS
The structure and dynamics of monsoon depressions N88-18102
MONTE CARLO METHOD
Unidimensional Rasch model and multidimensional data: An analytic approach
[PB88-105861] N88-18187
The hybrid Monte Carlo Algorithm and the chiral transition
[DE88-004305] N88-18341
An analytic model for ionization distributions produced in nanometer sites by protons
[DE88-003943] N88-18385
MORPHOLOGY
Bias, internal stress and substrate effects on the microstructure and properties of PVD-wear resistant coatings
[AERE-R-12360] N88-17798
New scientific findings on the morphology of aluminum oxide layers, serving as an adhesive basis
[MBB-Z-137/86] N88-17840
Collaborative studies of polar cap ionospheric dynamics
[AD-A187888] N88-18098
Histomorphometric analysis of rat bones after spaceflight aboard Cosmos-1667 biosatellite N88-18128
JPRS Report: Science and Technology. USSR: Space Biology and Aerospace Medicine, volume 21, no. 6, November - December 1987
[JPRS-USB-88-004] N88-18150
Morphological and functional state of the hypothalamo-hypophyseal neurosecretory system of rats flown aboard Cosmos-1667 N88-18156
Investigation of rat skeletal muscles following short-term spaceflight aboard Cosmos-1667 biosatellite N88-18157
Morphological study of early changes in rat bones in simulated weightlessness N88-18158
Morphological manifestations of primate adaptation to orthograde statics and walking erect N88-18162
Local stoichiometry and atomic interdiffusion during reactive metal/mercury-cadmium-telluride junction formation
[AD-A187554] N88-18488
MOTION PERCEPTION
Perception and control of simulated self motion
[AD-A187444] N88-18188
MOTION SICKNESS
Discrete adaptation to sensory conflict N88-18146
MOVING TARGET INDICATORS
Experiments for the high resolution detection of moving targets using a CO2 laser radar
[MBB-UA-1044/87] N88-17864
MTI-Interface (Moving Target Indication-Interface) for simple radar
[PB88-126578] N88-17884
MULTILAYER INSULATION
High-temperature properties of ceramic fibers and insulations for thermal protection of atmospheric entry and hypersonic cruise vehicles
[NASA-TM-100059] N88-17743
MULTIPATH TRANSMISSION
Wideband HF (High Frequency) modeling and simulation
[PB88-116116] N88-17874
MULTIPHASE FLOW
Turbulence interactions in single- and multi-phase turbulent mixing and combustion processes
[AD-A187505] N88-17960
MULTIPOLES
Application of state-multipole Heisenberg equations to Raman excitation dynamics
[DE88-003828] N88-17977
MULTIPROCESSING (COMPUTERS)
Role of broadcasting in multiprocessor systems N88-18201
Multiple-bus interconnection for future multiprocessor systems N88-18203
Implementation of a buddy failure recovery concept in the NOVAC system N88-18205
The case for a shared address space N88-18225
Performance evaluation of a loop interconnection structure N88-18229
Aspects of a multiprocessor architecture N88-18232

Parallelism at the microlevel: Cooperative microcontrollers with real time considerations N88-18246
A VLSI implementable block oriented data driven multiprocessor N88-18249
Multi-processor reduction machines N88-18253
A measurement-based study of concurrency in a multiprocessor [DE88-003536] N88-18260
A performance analysis of architectural scalability [DE88-003537] N88-18261
A multiprocessor scheme for the singular value decomposition [DE88-003591] N88-18288
Data prefetching in shared memory multiprocessors [DE88-003576] N88-18314

MULTISPECTRAL BAND SCANNERS
Autocorrelation of control points on 11-band multispectral imagery [AD-A188185] N88-18056

MULTIVARIATE STATISTICAL ANALYSIS
Identifiability of multivariate ARMA models [AD-A187394] N88-18350

MUSCLES
Muscle preservation in the study of bioenergetic effects of hypokinesia N88-18139
Investigation of rat skeletal muscles following short-term spaceflight aboard Cosmos-1667 biosatellite N88-18157
Morphological manifestations of primate adaptation to orthograde statics and walking erect N88-18162

MUSCULAR TONUS
Oxidative enzyme activity in healthy subjects and individuals with neurocirculatory dystonia during graded exercise N88-18170

MUTATIONS
Investigation of genetic structures of rat germ cells following flight aboard Cosmos-1514 biosatellite during their prenatal development N88-18155

MYOCARDIUM
Myosin Ca sup (2+), Mg sup (2+)-adenosine triphosphatase activity in ray myocardium following 30-day expose to 1.1 and 2.0 G N88-18141
Effect of cardioactive compounds on rat myocardium actomyosin following exposure to accelerations N88-18161

N

NAPHTHALENE
Transport and relaxation processes in supercritical fluids [DE88-004804] N88-18474

NASA PROGRAMS
Report of the Committee on the Space Station of the National Research Council [NASA-CR-181602] N88-17727
Into the thermosphere: The atmosphere explorers [NASA-SP-490] N88-18084
NASA patent abstracts bibliography: A continuing bibliography. Section 2: Indexes (supplement 32) [NASA-SP-7039(32)-SECT-2] N88-18511

NASA SPACE PROGRAMS
America plans for space [AD-A187465] N88-17713
Relationships between coronary heart disease risk factors and serum ionized calcium in Kennedy Space Center Cohort [NASA-TM-100979] N88-18177
Research and technology 1987 annual report of the Kennedy Space Center [NASA-TM-100303] N88-18548

NATURAL GAS
Geological evolution and analysis of confirmed or suspected gas hydrate localities. Volume 9: Formation and stability of gas hydrates of the Middle America Trench [DE88-001007] N88-18050

NAVIER-STOKES EQUATION
Solution of the three-dimensional Navier-Stokes equations for transonic flow using a multigrid method N88-17579
Navier-Stokes simulation of wind-tunnel flow using LU-ADI factorization algorithm [NASA-TM-100042] N88-17584
Navier-Stokes calculations and turbulence modeling in the trailing edge region of a circulation control airfoil N88-17587
Evaluation of a research circulation control airfoil using Navier-Stokes methods N88-17591
Navier-Stokes computations for circulation control airfoils N88-17592
Implicit solution of the incompressible Navier-Stokes equations in primitive variables on non-staggered grids N88-17930
A numerical study of unsteady two-dimensional subsonic compressible base flow N88-17931
The numerical and analytical study of bifurcation and multicellular flow instability due to natural convection between narrow horizontal isothermal cylindrical annuli at high Rayleigh numbers N88-17937
Instability and transition in curved channel flow N88-17938
Three-dimensional incompressible flowfield analysis for establishing rotor designs which optimize power extraction N88-17943
Free-surface flow phenomena ahead of a two-dimensional body in a viscous fluid N88-17944
A visual programming environment for the Navier-Stokes computer [NASA-CR-181615] N88-18299
Implementation and analysis of a Navier-Stokes algorithm on parallel computers [NASA-CR-181614] N88-18301

NAVIGATION
An overview of vision-based navigation for autonomous land vehicles 1986 [AD-A188186] N88-17640

NAVIGATION AIDS
Navigation recovery block design description [NASA-CR-182473] N88-18022

NAVY
NROSS (Navy Remote Ocean Sensing System): A force multiplier [AD-A186853] N88-18045
US Navy climatic study of the Mediterranean Sea [AD-A188264] N88-18107
The accommodative status in the dark of US Navy fighter pilots [AD-A188188] N88-18186

NEAR INFRARED RADIATION
Signal and data processing for IR sensors N88-18199

NERVOUS SYSTEM
Analysis and synthesis of adaptive neural elements [AD-A187047] N88-18316

NEUMANN PROBLEM
On an overdetermined Neumann problem [AD-A187451] N88-18352

NEURAL NETS
Introduction to a system for implementing neural net connections on SIMD architectures [NASA-CR-181612] N88-18279
Orthogonal patterns in binary neural networks [NASA-TM-100060] N88-18320

NEURONS
Analysis and synthesis of adaptive neural elements [AD-A187047] N88-18316

NEUTRAL ATOMS
Forces on neutral atoms due to electromagnetic fields [AD-A187461] N88-18396

NEUTRAL BEAMS
Benchmarks of neutral beam injection codes for stellarators [DE88-003786] N88-18428

NEUTRINOS
A look at Supernova 1987A [DE88-003411] N88-18531
Neutrino magnetic moment and time variation of solar neutrino flux [DE88-700687] N88-18542

NEUTRON DIFFRACTION
Magnetic rare earth superlattices [DE88-003483] N88-18465

NEUTRON IRRADIATION
Response of Fe-Cr-Mn austenitic alloys to thermal aging neutron irradiation [DE88-003415] N88-17785

NEUTRON SPECTRA
Effects of the neutron spectrum on mechanical property changes in low dose irradiations [DE88-003429] N88-17786

NEUTRON STARS
Stellar energy loss and anomalous contributions to the (photon photon) (neutrino antineutrino) interaction [DE88-700618] N88-18529
Hadron-quark phase transition in dense stars [DE88-003412] N88-18532

NICKEL
Dynamic recrystallization during high temperature low cycle fatigue of nickel [DE88-003224] N88-17788
Effects of ion implantation on cavitation erosion of a cobalt based metal/carbide alloy [AD-A187239] N88-17793
Growth and electronic properties of strained metal overlayers [DE87-010956] N88-18463

NICKEL ALLOYS
Diffusion studies in amorphous NiZr alloys [DE88-003009] N88-17781
The role of composition and microstructure gradients on weld metal properties and behavior [DE88-004956] N88-17791
Friction and wear of monolithic and fiber reinforced silicon-ceramics sliding against IN-718 alloy at 25 to 800 C in atmospheric air at ambient pressure [NASA-TM-100294] N88-17796

NICKEL CADMIUM BATTERIES
ESL batteries and multi-segment applications — ESA Simulation Language (ESL) [CS-1029/00-QFIN4] N88-17901

NICKEL OXIDES
The migration of grain boundaries in ceramic materials with particular reference to the sintering process [DE88-004085] N88-17808

NIGHT FLIGHTS (AIRCRAFT)
The accommodative status in the dark of US Navy fighter pilots [AD-A188188] N88-18186

NIGHT VISION
The accommodative status in the dark of US Navy fighter pilots [AD-A188188] N88-18186

NIGHTGLOW
The photons payload, G-494: A learning experience N88-17701

NITROGEN
CARS measurements of combustion. 1: Precision of thermometry [NAL-TR-939] N88-17769
Effects of ion implantation on cavitation erosion of a cobalt based metal/carbide alloy [AD-A187239] N88-17793

NOISE INTENSITY
Wideband HF (High Frequency) modeling and simulation [PB88-116116] N88-17874

NOISE POLLUTION
Cape Blanco wind farm feasibility study [DE88-003749] N88-18060
Supersonic and subsonic aircraft noise effects on animals: A literature survey [AD-A186922] N88-18373

NOISE REDUCTION
Silencium resonators (Silators) for the attenuation and elimination of sound [MBB-Z-546/83] N88-17841
The assessment of the sound insulation requirements for a large broadcasting studio, using a scale model: Practical details [BBC-RD-1987/21] N88-17878
An adaptive filtering technique for removing periodic noise from modal response data [DE88-002347] N88-17903

NOISE SPECTRA
Universal power spectra for wave turbulence: Applications to wind waves, flicker noise, solar wind spectrum and classical second sound N88-17879

NONDESTRUCTIVE TESTS
Durability and damage tolerance of aluminum castings [AD-A186444] N88-18013
The development of emission tomography for the nuclear industry [AERE-R-12319] N88-18014
Training guidelines in non-destructive testing techniques [DE88-700613] N88-18019
Institute for Materials Science and Engineering, nondestructive evaluation: Technical activities 1987 [PB88-153655] N88-18020
Application of nondestructive testing techniques to materials testing [AD-A187645] N88-18021
Institute for Materials Science and Engineering, Fracture and Deformation Division: Technical activities, 1987 [PB88-153622] N88-18039
Ultrasonic characterization of layered composite systems N88-18374
Scattering of impulsive acoustic waves by a semi-infinite crack in the plane interface of a half-space and a layer [PB88-126396] N88-18377

NONEQUILIBRIUM CONDITIONS
Studies in finite time thermodynamics [DE88-004531] N88-18500

NONEQUILIBRIUM FLOW
A study of numerical methods for hyperbolic conservation laws with stiff source terms [NASA-TM-100075] N88-18343

NONLINEAR EQUATIONS
Straightening and the Stanley decomposition for the (2;n)-nilpotent vectorfield [PB88-126685] N88-18336

NONLINEAR FILTERS
Nonlinear filtering and large deviations: A PDE-Control theoretic approach [AD-A187436] N88-18321

Dynamic observers as asymptotic limits of recursive filters: Special cases
[AD-A187578] N88-18324

NONLINEAR OPTICS
Nonlinear optics with broad-band lasers
[DE88-005026] N88-17992
Subpicosecond optical digital computation using phase conjugate parametric generators
[AD-A188279] N88-18411

NONLINEAR SYSTEMS
A finite element analysis of adhesively bonded composite joints including geometric nonlinearity, nonlinear viscoelasticity moisture diffusion and delayed failure
[AD-A187455] N88-17747
Design sensitivity analysis of nonlinear structural systems and numerical implementation with established finite element codes N88-18032

NONLINEARITY
Explicit approximations for strictly nonlinear oscillators with slowly varying parameters with applications to free electron lasers
[DE88-004116] N88-17984

NONPARAMETRIC STATISTICS
A generalized quantile estimator under censoring
[AD-A188280] N88-18364

NORTH AMERICA
Meteorological and aerosol measurements from the NOAA WP-3D aircraft during WATOX-86, January 4-9, 1986
[PB88-120660] N88-18079

NOVA LASER SYSTEM
High Z interaction physics on Nova
[DE88-004397] N88-18433

NOZZLE DESIGN
Design of supersonic Coanda jet nozzles N88-17599

NOZZLE FLOW
Experimental evaluation of a translating nozzle sidewall radial turbine N88-17656

NOZZLE GEOMETRY
Experimental evaluation of a translating nozzle sidewall radial turbine N88-17656

NOZZLE WALLS
Experimental evaluation of a translating nozzle sidewall radial turbine N88-17656

NUCLEAR FUSION
Understanding and accepting fusion as an alternative energy source
[DE88-004356] N88-18432

NUCLEAR MAGNETIC RESONANCE
NMR (Nuclear Magnetic Resonance) imaging for detecting binder/plasticizers in green-state structural ceramics
[DE88-003111] N88-17800
Instrumentation and quantitative methods of evaluation
[DE87-013639] N88-18017

NUCLEAR PHYSICS
The development of emission tomography for the nuclear industry
[AERE-R-12319] N88-18014
Research in experimental nuclear physics
[DE88-004100] N88-18397

NUCLEAR POWER PLANTS
Effects of commercial cladding on the fracture behavior of pressure vessel steel plates
[DE88-004333] N88-17790
Understanding and accepting fusion as an alternative energy source
[DE88-004356] N88-18432

NUCLEAR REACTIONS
Measurements of astrophysical reaction rates for radioactive samples
[DE88-004309] N88-18537
Gamma-ray and neutron spectroscopy of planetary surfaces and atmospheres
[DE88-004287] N88-18541

NUCLEAR REACTORS
Effects of the neutron spectrum on mechanical property changes in low dose irradiations
[DE88-003429] N88-17786

NUCLEAR STRUCTURE
Extension of nuclear structure data base searches for gamma-ray laser candidates
[DE88-004288] N88-17985
A nuclear structure study of the proposed gamma-ray laser candidate nucleus Re-186
[DE88-004299] N88-17986
Nuclear structure at intermediate energies
[TI88-002796] N88-18390

NUCLEATE BOILING
An experiment to investigate Rankine cycle two-phase microgravity issues
[DE88-004197] N88-17818

NUCLEATION
Mechanistic model for void distribution in flashing flow
[DE88-002948] N88-17928

NUCLEONS
Dynamics of coupled electron-nucleon motion in a laser field
[DE88-005063] N88-17994

NUMBER THEORY
The design of ultra high-speed numeric intensive systems (having fault tolerant and load balancing capabilities) N88-18196

NUMERICAL ANALYSIS
Numerical simulation of axisymmetric turbulent flow in combustors and diffusors
[NASA-CR-4115] N88-17582
A finite element analysis of adhesively bonded composite joints including geometric nonlinearity, nonlinear viscoelasticity moisture diffusion and delayed failure
[AD-A187455] N88-17747
Flame propagation in the approximation of straight-line trajectories of burning products
[DE88-700675] N88-17756
A numerical study of unsteady two-dimensional subsonic compressible base flow N88-17931
The numerical and analytical study of bifurcation and multicellular flow instability due to natural convection between narrow horizontal isothermal cylindrical annuli at high Rayleigh numbers N88-17937
Instability and transition in curved channel flow N88-17938
Periodic natural convection in a rectangular enclosure of low aspect ratio N88-17941
Recent progress in the p and h-p version on the finite element method
[AD-A187254] N88-18347
Eigenvalue problems
[AD-A188069] N88-18356
Coronal heating by means of helical magnetohydrodynamic turbulence
[AD-A187084] N88-18413

NUMERICAL CONTROL
Instrumentation and quantitative methods of evaluation
[DE87-013639] N88-18017

NUMERICAL STABILITY
Boundary layer calculation using digital computers
[REPT-MM-4] N88-17821

NUMERICAL WEATHER FORECASTING
On the dynamic estimation of relative weights for observation and forecast in numerical weather prediction
[NASA-CR-182531] N88-18106

NUTATION
Preliminary design of the ORION attitude control system
[AD-A187179] N88-17729
Observation model and parameter partials for the JPL VLBI parameter estimation software MASTERFIT-1987
[NASA-CR-182524] N88-18523

NYLON (TRADEMARK)
Optimization of the southern electrophoretic transfer method
[DE88-004527] N88-17765

O

OBLIQUENESS
An analysis of penetration and ricochet phenomena in oblique hypervelocity impact
[NASA-TM-100319] N88-18004

OBSERVATION
On observer problems for systems governed by partial differential equations
[AD-A187430] N88-18351
A two-stage isolated-word recognition system using discriminant analysis
[AD-A187425] N88-18360

OCEAN BOTTOM
A deep-water OBS (Ocean Bottom Seismometer) array with real-time telemetry
[AD-A187404] N88-18112
Rapid underway sediment classification by electrical methods
[AD-A187447] N88-18113
Rapid underway sediment classification by electrical methods
[AD-A187477] N88-18114
On the barotropic model of the ocean circulation
[AD-A188148] N88-18118

OCEAN CURRENTS
Numerical simulations of the California current: Filament formation as related to baroclinic instability
[AD-A187573] N88-18115
Energy transfers for multilayer hydrodynamic ocean models: General formulation and specific examples
[AD-A187604] N88-18116
On the barotropic model of the ocean circulation
[AD-A188148] N88-18118

OCEAN DATA ACQUISITIONS SYSTEMS
NROSS (Navy Remote Ocean Sensing System): A force multiplier
[AD-A186853] N88-18045

OCEAN MODELS
NASA Oceanic Processes Program
[NASA-TM-4025] N88-18109
Numerical simulations of the California current: Filament formation as related to baroclinic instability
[AD-A187573] N88-18115
Energy transfers for multilayer hydrodynamic ocean models: General formulation and specific examples
[AD-A187604] N88-18116
On the barotropic model of the ocean circulation
[AD-A188148] N88-18118

OCEAN SURFACE
Radar returns from ground clutter in vicinity of airports N88-17624
Numerical simulations of the California current: Filament formation as related to baroclinic instability
[AD-A187573] N88-18115

OCEANOGRAPHIC PARAMETERS
NROSS (Navy Remote Ocean Sensing System): A force multiplier
[AD-A186853] N88-18045
CTD observations in the coastal transition zone off northern California, 16-25 February 1987
[AD-A187283] N88-18111

OCEANOGRAPHY
NASA Oceanic Processes Program
[NASA-TM-4025] N88-18109
Coordination: Southeast continental shelf studies
[DE88-003680] N88-18110

OCEANS
Numerical studies of propagation of Lg waves across ocean continent boundaries using the Representation Theorem (RT) N88-18085

OFFSHORE PLATFORMS
Geological evolution and analysis of confirmed or suspected gas hydrate localities. Volume 9: Formation and stability of gas hydrates of the Middle America Trench
[DE88-001007] N88-18050
Analysis of wind turbines on offshore support structures excited by random wind and random waves
[DE88-004772] N88-18074

OIL EXPLORATION
Three-dimensional transient electromagnetic modeling for exploration geophysics N88-18047

OILS
Characterization of the arc/spark excitation sources used in the spectrometric oil analysis program
[AD-A187131] N88-17758

ON-LINE SYSTEMS
MICRO system for control, acquisition and processing of experimental data
[DE88-700724] N88-18278

ONBOARD DATA PROCESSING
An expert system to support the verification/validation of flight-critical software
[MBB-UT-102/87] N88-17852

ONSAGER RELATIONSHIP
Application of Onsager's reciprocity relations to interface motion
[DE88-003286] N88-18327

OPENINGS
Theoretical and observational problems with Holes in the far UV dayglow
[AD-A188190] N88-18100

OPERATING SYSTEMS (COMPUTERS)
Clouds: A support architecture for fault tolerant, distributed systems N88-18206
The mapping of parallel algorithms to reconfigurable parallel architectures N88-18209
Performance and evaluation at the Center for Supercomputing Research and Development
[DE88-003563] N88-18456

OPERATIONS RESEARCH
Operations research in management?
[MBB-Z-138/87] N88-17835

OPERATOR PERFORMANCE
Investigation of effects of short-term exposure to high concentrations of carbon monoxide on operator's psychophysiological functions N88-18133

OPERATORS (MATHEMATICS)
Application of state-multipole Heisenberg equations to Raman excitation dynamics
[DE88-003828] N88-17977
Schwarz splitting and template operators
[AD-A187956] N88-18370

OPTICAL COMMUNICATION
Signal processing studies program optical signal amplification, volume 1
[AD-A188055] N88-17897
Design and implementation of a fiber optic RS232 link
[AD-A187319] N88-18409
Microwave semiconductor research-materials, devices and circuits
[AD-A187121] N88-18444
OPTICAL COMPUTERS
Optical symbolic processor for expert system execution
[AD-A187494] N88-18268
OPTICAL DATA PROCESSING
Image texture classification with an optical crossbar interconnected processor N88-18202
OPTICAL DENSITY
Perception and control of simulated self motion
[AD-A187444] N88-18188
OPTICAL EQUIPMENT
The magic of carrier patterns in moire interferometry
[AD-A187582] N88-17748
Remote sensing of atmospheric crosswinds by utilizing speckle-turbulence interaction and optical heterodyne detection
[AD-A187580] N88-18052
Fabrication and evaluation of transmissive multilayer optics for 8 keV X-rays
[DE88-003999] N88-18402
A chemical precursor to optical damage. Studies by laser ionization mass spectrometry
[DE88-004321] N88-18408
Subpicosecond optical digital computation using phase conjugate parametric generators
[AD-A188279] N88-18411
Microwave semiconductor research-materials, devices and circuits
[AD-A187121] N88-18444
Optical memory cards: A comparison with other current technologies and potential military applications
[AD-A187287] N88-18512
OPTICAL FIBERS
Wide band data transmission system using optical fibers
[DE88-004555] N88-17889
The use of optical fibers for shock pressure and timing measurements at high pressures
[DE88-004012] N88-17971
OPTICAL HETERODYNING
Remote sensing of atmospheric crosswinds by utilizing speckle-turbulence interaction and optical heterodyne detection
[AD-A187580] N88-18052
OPTICAL MEASUREMENT
Evaluation of a temperature remote sensing technique
[AD-A187885] N88-18053
OPTICAL MEMORY (DATA STORAGE)
Optical memory cards: A comparison with other current technologies and potential military applications
[AD-A187287] N88-18512
OPTICAL PROPERTIES
Relaxing the brightness constancy assumption in computing optical flow
[AD-A187437] N88-18410
Optical characterization of GaAs/sub 1-x/Sb/sub x/ and GaAs/sub 1-x/Sb/sub x/GaAs strained layer superlattices
[DE88-003393] N88-18464
OPTICAL RADAR
Airborne Wind Shear Detection and Warning Systems: First Combined Manufacturers' and Technologists' Conference
[NASA-CP-10006] N88-17616
Lidar windshear detection and avoidance: Performance and technical assessment N88-17626
Airborne Doppler lidar detection of wind shear. Results of performance analysis N88-17627
Experiments for the high resolution detection of moving targets using a CO2 laser radar
[MBB-UA-1044/87] N88-17864
OPTICAL RESONATORS
The 80 fsec soliton-like pulses from an optical-nonlinear fiber resonator
[PB88-127303] N88-18403
OPTICAL WAVEGUIDES
Light Electronic Control System (LECOS): A proposal for a interconnected error-tolerant, optoelectronic control system
[MBB-UT-004/87] N88-17836
POLYPHEM, a universal defensive missile with optical waveguides guidance
[MBB-UA-1045/87] N88-17862
Formation of optical waveguides by ion implantation
[DE88-003894] N88-18407
OPTIMAL CONTROL
Nonlinear filtering and large deviations: A PDE-Control theoretic approach
[AD-A187436] N88-18321
Viscosity methods in optimal control of distributed systems
[AD-A188086] N88-18357
OPTIMIZATION
Optimisation of military compressors for weight and volume N88-17649
Specification of an engine and its components starting from a consideration of aircraft missions N88-17651
The design of impedance- matching networks for broadband antennas
[AD-A187600] N88-17895
Optimal design and parameter identification of flexible rotor-bearing systems N88-18002
Applications of energy density theory in cyclic plasticity
[AD-A186947] N88-18023
Continuous deformation algorithm on the product space of unit simplices, revised version
[PB88-114210] N88-18281
Graph transformation algorithms for array memory optimization in applicative languages
[DE88-004727] N88-18283
Experiences with serial and parallel algorithms for channel routing using simulated annealing
[NASA-CR-182530] N88-18289
A parallel quasi-Newton method for partially separable large scale minimization
[DE88-003592] N88-18309
Strongly sequential term rewriting systems
[PB88-126693] N88-18334
Viscosity methods in optimal control of distributed systems
[AD-A188086] N88-18357
Optimization of outlet channel of plasma ion source
[DE88-700471] N88-18415
On the maneuvering of vehicles
[AD-A187632] N88-18521
OPTOELECTRONIC DEVICES
Light Electronic Control System (LECOS): A proposal for a interconnected error-tolerant, optoelectronic control system
[MBB-UT-004/87] N88-17836
ORDER-DISORDER TRANSFORMATIONS
Positron-annihilation 2D-ACAR studies of disordered and defected alloys
[DE88-003118] N88-18454
ORGANIC COMPOUNDS
Supercritical fluid extraction-gas chromatography of Volatile Organic Compounds (VOC) from tenax devices
[PB88-124300] N88-17759
ORGANIC MATERIALS
Trace analysis by MS/MS on a double focussing mass spectrometer
[AD-A187954] N88-17973
ORGANIZATIONS
Hydrogen Energy Coordinating Committee: Summary of DOE hydrogen programs for FY 1987
[DE88-003960] N88-17811
ORGANOMETALLIC COMPOUNDS
Chemical activation of molecules by metals: Experimental studies of electron distributions and bonding
[DE88-004465] N88-18393
OROGRAPHY
Systematic errors of the FSU global spectral model N88-18103
ORTHOGONAL FUNCTIONS
Spectral iterative technique with Gram-Schmidt orthogonalization
[PB88-127451] N88-18338
ORTHOGONALITY
Orthogonal patterns in binary neural networks
[NASA-TM-100060] N88-18320
ORTHOSTATIC TOLERANCE
Comparative evaluation of orthostatic stability following immersion in horizontal and vertical positions N88-18143
Effect of antiorthostatic position and different illumination on sensitivity of skin in upper half of the body to ultraviolet radiation N88-18145
Effect of exogenous cardiosynchronized counterpulsation on human regional and central hemodynamics N88-18163
ORTHOTROPISM
An analytical study of the effects of transverse shear deformation and anisotropy on natural vibration frequencies of laminated cylinders
[NASA-TM-100554] N88-17739
OSCILLATING FLOW
Microcomputer analysis of regenerative heat exchangers for oscillating flow
[DE88-001773] N88-17945
OSCILLATIONS
Lifting-surface theory of oscillating propellers in compressible flow
[NAL-TR-943] N88-17613
Betatron oscillations in a free electron laser
[DE88-004859] N88-17990
Modal testing the EOLE
[DE88-003795] N88-18068
Modal testing of a very flexible 110 m wind turbine structure
[DE88-003796] N88-18072
Statistical studies of low frequency oscillations in satellite-observed stratospheric temperatures N88-18086
Probability bounds for M-Skorohod oscillations
[AD-A187981] N88-18371
OSCILLATORS
Fundamental cyclotron frequency generation from a cusptron oscillator
[AD-A188187] N88-17898
Conceptual designs of a 50 NM FEL (Free-Electron Laser) oscillator and a 20-40 NM SASE (Self-Amplified Spontaneous Emission) amplifier
[DE88-003150] N88-17974
Explicit approximations for strictly nonlinear oscillators with slowly varying parameters with applications to free electron lasers
[DE88-004116] N88-17984
Tapered wiggler analysis of high gain free electron laser oscillators
[AD-A187997] N88-17997
OSMIUM
Johnson noise thermometer for high radiation and high temperature environments
[DE88-003770] N88-17911
OTOLITH ORGANS
Two-dimensional static otolith model N88-18167
OUTLETS
Optimization of outlet channel of plasma ion source
[DE88-700471] N88-18415
OVERPRESSURE
Modeling of the non-auditory response to blast overpressure
[AD-A187397] N88-18184
OXIDATION
Low temperature reactivity of chars towards oxygen, appendix E2
[DE88-004088] N88-17760
The influence of the heating procedure on the oxidation behaviour of NiAl studied by XPS
[AERE-R-12498] N88-17776
Lipid peroxidation in rat tissues with exposure to antiorthostatic hypokinesia, exercise and immobilization stress N88-18159
Oxidative enzyme activity in healthy subjects and individuals with neurocirculatory dystonia during graded exercise N88-18170
Optical measurements of surface oxide layer formation on metal films
[DE88-003163] N88-18405
Formation of optical waveguides by ion implantation
[DE88-003894] N88-18407
Effects of X irradiation and high field electron injection on the electrical properties of rapid thermal oxides
[DE88-002642] N88-18461
OXIDATION RESISTANCE
Beneficial and detrimental effects of silica in the high temperature oxidation of 20Cr/25Ni/Nb stainless steel
[AERE-R-12667] N88-17779
OXIDE FILMS
New scientific findings on the morphology of aluminum oxide layers, serving as an adhesive basis
[MBB-Z-137/86] N88-17840
Effect of the gate oxide thickness on the speed of MOS integrated circuits
[PB88-155783] N88-17910
Optical measurements of surface oxide layer formation on metal films
[DE88-003163] N88-18405
Effects of X irradiation and high field electron injection on the electrical properties of rapid thermal oxides
[DE88-002642] N88-18461
Freestanding films of YBa2Cu3O/sub 6.9/
[DE88-003995] N88-18471
OXYGEN
The photons payload, G-494: A learning experience N88-17701
Development and application of oxygen flow tagging for velocity measurements and flow visualization in turbulent three-dimensional supersonic flows
[AD-A187982] N88-17714
Materials development for JPL oxygen plant
[DE88-003067] N88-17752
Low temperature reactivity of chars towards oxygen, appendix E2
[DE88-004088] N88-17760

Theoretical and observational problems with Holes in the far UV dayglow
[AD-A188190] N88-18100
Effect of oxygen inhalation on respiratory function during exercise and exposure to added resistance to respiration N88-18164

OZONE
Tropospheric ultraviolet radiation: Assessment of existing data and effect on ozone formation
[PB88-130133] N88-18095
Experimental measurements of the uptake of ozone in rats and human subjects
[PB88-125422] N88-18149

P

PACIFIC OCEAN
Geological evolution and analysis of confirmed or suspected gas hydrate localities. Volume II: Formation and stability of gas hydrates of the Middle America Trench
[DE88-001007] N88-18050
CTD observations in the coastal transition zone off northern California, 16-25 February 1987
[AD-A187283] N88-18111
PARABOLAS
Inversion of parabolic and paraboloidal projections
[AD-A187538] N88-18380
PARALLEL COMPUTERS
Massive fine-grain parallelism in array computation: A data flow solution N88-18254
Finely grained parallelism in an applicative architecture N88-18256
Implementation and analysis of a Navier-Stokes algorithm on parallel computers
[NASA-CR-181614] N88-18301
PARALLEL PROCESSING (COMPUTERS)
The design of ultra high-speed numeric intensive systems (having fault tolerant and load balancing capabilities) N88-18196
Hardware implementation for special functions. An application for combat simulation N88-18197
On parallelism in software/hardware design tools N88-18200
Role of broadcasting in multiprocessor systems N88-18201
Image texture classification with an optical crossbar interconnected processor N88-18202
A large-grain dataflow architecture N88-18207
The mapping of parallel algorithms to reconfigurable parallel architectures N88-18209
A distributed system architecture based on macro dataflow model N88-18210
Distributed control of large parallel computers N88-18215
Experiments with parallel program execution on a network of workstations N88-18217
Predicate analysis for parallel program generation N88-18222
An investigation of parallelism in rule based systems N88-18223
The next generation of hypercube computers N88-18226
A parallel computer based on cube connected cycles N88-18227
Investigations on the usefulness of the Massively Parallel Processor for study of electronic properties of atomic and condensed matter systems
[NASA-CR-182514] N88-18259
A measurement-based study of concurrency in a multiprocessor
[DE88-003536] N88-18260
Features of a TeraFlop supercomputer
[DE88-003540] N88-18263
The impact of hierarchical memory systems on linear algebra algorithm design
[DE88-003574] N88-18274
PSolve: A concurrent algorithm for solving sparse systems of linear equations
[DE88-003584] N88-18275
Introduction to a system for implementing neural net connections on SIMD architectures
[NASA-CR-181612] N88-18279
Programming methodology and performance issues for advanced computer architectures
[DE88-003098] N88-18287
A multiprocessor scheme for the singular value decomposition
[DE88-003591] N88-18288
Parallel access to synchronization variables
[DE88-003570] N88-18306
Loop coalescing: A compiler transformation for parallel machines
[DE88-003571] N88-18307
The performance of software-managed multiprocessor caches on parallel numerical programs
[DE88-003590] N88-18308
A parallel quasi-Newton method for partially separable large scale minimization
[DE88-003592] N88-18309
Performance studies of a parallel processor for large linear programming problems
[PB88-121611] N88-18310
Dynamic processor self-scheduling for general parallel nested loops
[DE88-003572] N88-18311
Parallel discrete event simulation: A shared memory approach
[NASA-CR-182521] N88-18312
Deadlock prevention in processor self-scheduling for parallel nested loops
[DE88-003573] N88-18313
Parallel garbage collection on a virtual memory system
[DE88-003567] N88-18317
Fast and practical parallel polynomial interpolation
[DE88-003530] N88-18328
Center for Supercomputing Research and Development
[DE88-003564] N88-18466
PARALLEL PROGRAMMING
Experimenting with parallel programing in logic N88-18240
Parallel architectures for logic programming N88-18241
Programming language translation for multicomputers N88-18244
Parallelism at the microlevel: Cooperative microcontrollers with real time considerations N88-18246
FX-87 reference manual, edition 1.0
[AD-A187031] N88-18273
Experiences with serial and parallel algorithms for channel routing using simulated annealing
[NASA-CR-182530] N88-18289
PARAMAGNETISM
Superconducting and magnetic properties of Fe-doped oxide superconductors
[DE88-003024] N88-18451
PARAMETER IDENTIFICATION
Parameter identification and sensitivity analysis for a robotic manipulator arm
[NASA-CR-181608] N88-18272
PARAMETERIZATION
Parametric study of choke flutter with a linear theory N88-17673
Parameterization of radiative transfer in the Earth's atmosphere with specific applications to clouds N88-18087
Effect of hypercapnic-hypoxic test on cariorespiratory parameters of individuals with neurocirculatory dystonia N88-18169
Unidimensional Rasch model and multidimensional data: An analytic approach
[PB88-105861] N88-18187
Hierachical object recognition using libraries of parameterized model sub-parts
[AD-A187476] N88-18322
Semiempirical studies of atomic structure
[DE88-004096] N88-18392
PARSING ALGORITHMS
Semi-applicative programming N88-18239
PARTIAL DIFFERENTIAL EQUATIONS
Programming methodology and performance issues for advanced computer architectures
[DE88-003098] N88-18287
Nonlinear filtering and large deviations: A PDE-Control theoretic approach
[AD-A187436] N88-18321
A multigrid preconditioner applied to a two-dimensional convection-diffusion problem
[DE88-004765] N88-18329
Parallels between control PDE's (Partial Differential Equations) and systems of ODE's (Ordinary Differential Equations)
[NASA-CR-182487] N88-18331
On observer problems for systems governed by partial differential equations
[AD-A187430] N88-18351
Applications of Lie group methods to the equations of magnetohydrodynamics N88-18422
PARTICLE ACCELERATORS
The implementation of artificial intelligence in control systems
[DE88-003497] N88-18318
The numerical simulation of accelerator components
[DE87-011597] N88-18423
PARTICLE IN CELL TECHNIQUE
Performance and optimization of direct implicit time integration schemes for use in electrostatic particle simulation codes
[DE88-003254] N88-18381
PARTICLE INTERACTIONS
Nuclear structure at intermediate energies
[TI88-002796] N88-18390
PARTICLE MOTION
Dynamics of coupled electron-nucleon motion in a laser field
[DE88-005063] N88-17994
PARTICLE SIZE DISTRIBUTION
Mechanisms of wear in single- and two-phase materials
[DE88-003846] N88-17806
Turbulence interactions in single- and multi-phase turbulent mixing and combustion processes
[AD-A187505] N88-17960
PARTICLE TRACKS
An analytic model for ionization distributions produced in nanometer sites by protons
[DE88-003943] N88-18385
PARTICLES
Ice-shelf response to ice-stream discharge fluctuation. Part 1: Unconfined ice tongues
[AD-A188147] N88-18117
PASSENGER AIRCRAFT
The intelligent wing. Aerodynamic development direction for future passenger aircraft
[MBB-UT-006/87] N88-17848
PASSIVITY
A review of pitting corrosion in high temperature aqueous solutions
[DE88-003547] N88-17787
PATENT POLICY
NASA patent abstracts bibliography: A continuing bibliography. Section 2: Indexes (supplement 32)
[NASA-SP-7039(32)-SECT-2] N88-18511
PATTERN RECOGNITION
Hierachical object recognition using libraries of parameterized model sub-parts
[AD-A187476] N88-18322
PATTERN REGISTRATION
A smart, mapping, charting and geodesy control generator, phase 1
[AD-A188184] N88-18055
Autocorrelation of control points on 11-band multispectral imagery
[AD-A188185] N88-18056
PATTERNS
Orthogonal patterns in binary neural networks
[NASA-TM-100060] N88-18320
PAVEMENTS
Evaluation of bituminous materials used in pavement recycling projects at Tyndall, MacDill, and Hurlburt Air Force Bases
[AD-A188068] N88-17871
PAYLOAD INTEGRATION
Laser investigations for payload G-652 prior to filing pre-flight accommodation requirements N88-17894
PEACETIME
The military techniques of tomorrow. A contribution to active peace assurance
[MBB-UA-1049/87] N88-17860
PEELING
Effect of post-cure heat-treatment on static and fatigue behaviour of XAS-914C carbon fibre composite
[AD-A186943] N88-17735
PENETRATION
Space station integrated wall damage and penetration damage control. Task 5: Space debris measurement, mapping and characterization system
[NASA-CR-179281] N88-17688
Penetration theory for inclined and moving shaped charges
[MBB-UA-940/86] N88-17861
An analysis of penetration and ricochet phenomena in oblique hypervelocity impact
[NASA-TM-100319] N88-18004
Penetration depth measurements of YBa2Cu3O/sub 7-delta/ at 4 MHz
[DE88-003493] N88-18478
PERFORMANCE PREDICTION
Method for predicting performance limits of centrifugal compressors N88-17677
A strategy for failure prediction N88-18243
PERFORMANCE TESTS
Design and test of a high blade speed, high work capacity transonic turbine N88-17658
Design and testing of a front stage for an advanced high pressure compressor N88-17679
Simulation test beds for the space station electrical power system
[NASA-TM-100786] N88-17715

Development of vertical takeoff aircraft with turbojet engines in Germany N88-17822
Flight testing of fighter aircraft [MBB/LKE-62/S/PUB/292] N88-17844
Testing of a tail rotor system in a fiber composite type of construction [MBB-UD-472/86] N88-17854
Solid-state voltage standard performance and design guidelines [PB88-123757] N88-17905
Analysis of the performance of an air-water heat pump: Regulation of intrinsic performances [DE88-900241] N88-18061
Wake effects in a Fayette 95-IIS wind turbine array [DE88-001103] N88-18063
Modal testing the EOLE [DE88-003795] N88-18066
Preliminary results from the dynamic response testing of the Westinghouse 600-kW wind turbine [DE88-001123] N88-18070
Signal and data processing for IR sensors N88-18199
A performance analysis of architectural scalability [DE88-003537] N88-18261
Factors causing unexpected variations in Ada benchmarks [AD-A187231] N88-18291
On the maneuvering of vehicles [AD-A187632] N88-18521

PERIODIC VARIATIONS
An adaptive filtering technique for removing periodic noise from modal response data [DE88-002347] N88-17903

PERMUTATIONS
The Lambda network: A new permutation network [DE88-003568] N88-18305

PERSONAL COMPUTERS
Satellite interference analysis and simulation using personal computers [NASA-CR-182522] N88-17890
Personal computers and All-In-1: Document transfer and translation [DE88-003760] N88-18264
TABLET: The personal computer of the year 2000 [NASA-CR-182528] N88-18267

PERSONNEL
Relationships between coronary heart disease risk factors and serum ionized calcium in Kennedy Space Center Cohort [NASA-TM-100979] N88-18177
The accommodative status in the dark of US Navy fighter pilots [AD-A188188] N88-18186

PERTURBATION THEORY
A dynamical system/coherent structure approach to the fully developed turbulent wall layer N88-17578
Application of state-multipole Heisenberg equations to Raman excitation dynamics [DE88-003828] N88-17977
Theoretical studies of atomic transitions [DE88-004719] N88-18389
Nuclear structure at intermediate energies [TI88-002796] N88-18390

PETRI NETS
Strategies for concurrent processing of complex algorithms N88-18236

PHARMACOLOGY
Scaling physiological pharmacokinetic models by physiological time [DE88-000335] N88-18173

PHASE CONJUGATION
Self-pumped phase conjugation in a supersonically flowing medium [AD-A188281] N88-17998
Subpicosecond optical digital computation using phase conjugate parametric generators [AD-A188279] N88-18411

PHASE DIAGRAMS
Metal hydrides [DE88-005083] N88-17766
Electronic structure of random alloys and the theory of ordering processes [DE88-004476] N88-18394
Transport and relaxation processes in supercritical fluids [DE88-004804] N88-18474

PHASE SHIFT
Magnetic rare earth superlattices [DE88-003483] N88-18465

PHASE TRANSFORMATIONS
Application of inverse gas chromatography to fluidity studies [DE88-002896] N88-17750
Influence of convection on microstructure [NASA-CR-182489] N88-17784
Irradiation effects in metals [DE88-004272] N88-17789
The role of composition and microstructure gradients on weld metal properties and behavior [DE88-004956] N88-17791
Fabrication, phase transformation studies and characterization of SiC-AlN-Al2OC ceramics [DE88-004053] N88-17807
Advanced materials for solid oxide fuel cells [DE88-002338] N88-18071
Application of Onsager's reciprocity relations to interface motion [DE88-003286] N88-18327
Electronic structure of random alloys and the theory of ordering processes [DE88-004476] N88-18394
High temperature processing of superconducting Y1Ba2Cu3O6.9 [DE88-003002] N88-18449
Magnetic rare earth superlattices [DE88-003483] N88-18465
Order-disorder transition of Au and Pt (110) surfaces: The significance of relaxations and vibrations [DE88-004651] N88-18473
Superconductivity and phase stability in the heavy rare earth quaternary compounds RBa2Cu3O7 (R = Ho, Er, Tm, Yb, Lu) [DE88-003478] N88-18476
Superconducting properties and structural characterization of high T/sub c/ oxides [DE88-003479] N88-18477
Hadron-quark phase transition in dense stars [DE88-003412] N88-18532

PHILOSOPHY
Resonance, information, and the primacy of process: Ancient light on modern information and communication theory and technology N88-18506

PHONETICS
Speech recognition: Acoustic-phonetic knowledge acquisition and representation [AD-A187293] N88-17893

PHOSPHORIC ACID
The effect on initial bond strength and durability of a Phosphoric Acid Dip (PAD) following chromic acid anodising of aluminum [ARE-TM(UMM)-87402] N88-17772

PHOSPHORYLATION
Muscle preservation in the study of bioenergetic effects of hypokinesia N88-18139

PHOTOABSORPTION
Light absorption by an atom moving inside a spherical box [AD-A187241] N88-18395

PHOTOCHEMICAL REACTIONS
Energy transfer and photochemistry in biomimetic solar conversion [PB88-130026] N88-18057
Photochemical solar energy conversion utilizing semiconductors localized in membrane mimetic systems [DE88-002887] N88-18065

PHOTOGRAMMETRY
Earth resources: A continuing bibliography with indexes (supplement 56) [NASA-SP-7041(56)] N88-18051

PHOTOIONIZATION
Two-photon (VUV and visible) resonant ionization spectroscopy of atoms and molecules [DE88-004332] N88-18388
Theoretical studies of atomic transitions [DE88-004719] N88-18389

PHOTOLUMINESCENCE
Optical characterization of GaAs/sub 1-x/Sb/sub x/ and GaAs/sub 1-x/Sb/sub x/GaAs strained layer superlattices [DE88-003393] N88-18464

PHOTOLYSIS
Laser studies of the dynamics of free radical reactions [DE88-004431] N88-17989

PHOTOMETERS
The photons payload, G-494: A learning experience N88-17701

PHOTOMULTIPLIER TUBES
Signal processing studies program optical signal amplification, volume 1 [AD-A188055] N88-17897

PHOTONS
Performance of a photon counting microchannel plate intensifier with wedge and strip image readout [DE88-003831] N88-17970
Application of state-multipole Heisenberg equations to Raman excitation dynamics [DE88-003828] N88-17977
The development of emission tomography for the nuclear industry [AERE-R-12319] N88-18014

PHOTOSYNTHESIS
Energy transfer and photochemistry in biomimetic solar conversion [PB88-130026] N88-18057
Research on a solar biotechnology based on the culture of photosynthetic cells [DE88-900129] N88-18120
Spectroscopic studies of energy transfer in photosynthetic reaction centers of higher plants [DE88-003850] N88-18121

PHTHALOCYANIN
Electrochromic cells with lutetium diphthalocyanine and semisolid polymer electrolytes [AD-A188031] N88-18078

PHYSICAL EXERCISE
Lipid peroxidation in rat tissues with exposure to antiorthostatic hypokinesia, exercise and immobilization stress N88-18159
Effect of oxygen inhalation on respiratory function during exercise and exposure to added resistance to respiration N88-18164
Oxidative enzyme activity in healthy subjects and individuals with neurocirculatory dystonia during graded exercise N88-18170

PHYSICS AND CHEMISTRY EXPERIMENT IN SPACE
The challenge of G-376 N88-17705

PHYSIOLOGICAL EFFECTS
Ultra-low frequency vibration data acquisition concerns in operating flight simulators [DE88-004795] N88-17687
JPRS Report: Science and Technology. USSR: Space Biology and Aerospace Medicine, volume 21, no. 5, September - October 1987 [JPRS-USB-88-003] N88-18122
Effect of spaceflight factors on primate's blood circulation N88-18124
Inflight simian circadian rhythms and temperature homeostasis aboard Cosmos-1514 biosatellite N88-18125
Effect of spaceflight factors on primate hydration homeostasis N88-18126
Investigation of effects of short-term exposure to high concentrations of carbon monoxide on operator's psychophysiological functions N88-18133
Results of long-term electrocardiographic monitoring of cosmonauts N88-18152
Effect of spaceflight factors on biological material flown aboard Cosmos-1514 biosatellite N88-18154
Lipid peroxidation in rat tissues with exposure to antiorthostatic hypokinesia, exercise and immobilization stress N88-18159
Certain aspects of human metabolism during spaceflights of varying duration [NASA-TT-20215] N88-18181
Basic results of medical studies during prolonged manned flights on-board the Salyut-7/Soyuz-T orbital complex [NASA-TT-20217] N88-18182
Modeling of the non-auditory response to blast overpressure [AD-A187397] N88-18184

PHYSIOLOGICAL RESPONSES
Physiological and ecological implications of coupled heat- and water-transport mechanisms of endotherms and vegetation [DE88-004170] N88-18081
Membrane model of cupula or vestibular semicircular canals N88-18132
Comparative evaluation of stress repsonse of rats to different methods of simulating some effects of weightlessness N88-18144
Second All-Union Conference on Physiology of Extreme States and Individual Protection of Man N88-18147
JPRS Report: Science and Technology. USSR: Space Biology and Aerospace Medicine, volume 21, no. 6, November - December 1987 [JPRS-USB-88-004] N88-18150
Polar worker adaptability to Antarctic high altitudes N88-18165
Effect of hypercapnic-hypoxic test on cariorespiratory parameters of individuals with neurocirculatory dystonia N88-18169
Hemodynamic effects of beta-adrenergic blocking with obsidan in clinostatic and orthostatic positions N88-18171
Supersonic and subsonic aircraft noise effects on animals: A literature survey [AD-A186922] N88-18373

PHYSIOLOGY
Ultra-low frequency vibration data acquisition concerns in operating flight simulators [DE88-004795] N88-17687
Evaluation of spare room in cerebrospinal system using noninvasive methods N88-18137

Scaling physiological pharmacokinetic models by physiological time
[DE88-000335] N88-18173

PICOSECOND PULSES

Subpicosecond optical digital computation using phase conjugate parametric generators
[AD-A188279] N88-18411

PIEZOELECTRICITY

Piezoelectric laminates for torsional and bending model control: Theory and experiment N88-18029

Recent progress in the dynamic applications of piezoelectric crystals N88-18460

PILOT PERFORMANCE

Are windshear training aid recommendations appropriate for other than large jet transports? Pilot procedures: Shear models N88-17835

Trends in the distribution of tasks between commercial pilots and flight control systems
[MBB-UT-008/87] N88-17851

Cardiovascular and subjective measures of task demand in a low workload monitoring task
[REPT-8804] N88-18176

PILOT SELECTION

The accommodative status in the dark of US Navy fighter pilots
[AD-A188188] N88-18186

PILOT TRAINING

Are windshear training aid recommendations appropriate for other than large jet transports? Pilot procedures: Shear models N88-17835

Windshear training aid. Volume 1: Overview, pilot guide, training program
[PB88-127196] N88-17837

The accommodative status in the dark of US Navy fighter pilots
[AD-A188188] N88-18186

PINS

Computed stress and strain distributions under interference fit and after coldworking
[AD-A186950] N88-18024

PIONS

Research in experimental nuclear physics
[DE88-004100] N88-18397

PIPE FLOW

On some asymptotics of laminar flow in a coiled pipe N88-17936

PIPELINING (COMPUTERS)

Massive fine-grain parallelism in array computation: A data flow solution N88-18254

PIPES (TUBES)

Cost 501 Project UK10 part 3: Thermal fatigue damage of Fecralloy steel-sprayed and co-extruded tubing
[AERE-R-12230] N88-18026

PISTON ENGINES

Free-piston Stirling engine diaphragm-coupled heat-actuated heat pump component technology program, phase 1C
[DE88-003654] N88-17949

PISTONS

Free-piston Stirling engine diaphragm-coupled heat-actuated heat pump component technology program, phase 1C
[DE88-003654] N88-17949

PITTING

Studies of the initiation of pitting corrosion on stainless steels
[AERE-M-3615] N88-17778

A review of pitting corrosion in high temperature aqueous solutions
[DE88-003547] N88-17787

Corrosion behavior of sputter-deposited aluminum-based alloys exposed to chloride solutions
[AD-A187262] N88-17794

PITUITARY GLAND

Morphological and functional state of the hypothalamo-hypophyseal neurosecretory system of rats flown aboard Cosmos-1667 N88-18156

PLANAR STRUCTURES

The dynamics of coupled planar rigid bodies. Part 1: Reduction, equilibria and stability
[AD-A187467] N88-18042

PLANETARY ATMOSPHERES

Extended atmospheres of outer planet satellites and comets
[NASA-CR-181449] N88-18540

Gamma-ray and neutron spectroscopy of planetary surfaces and atmospheres
[DE88-004287] N88-18541

PLANTS (BOTANY)

Spectroscopic studies of energy transfer in photosynthetic reaction centers of higher plants
[DE88-003850] N88-18121

Species biology and potential for controlling four exotic plants (Ammophila arenaria, Carpobrotus edulis, Cortaderia jubata and Gasoul crystallinum) on Vandenberg Air Force Base, California
[NASA-TM-100980] N88-18148

PLASMA CONTROL

D-3He fuels in a field-reversed configuration
[IPPJ-855] N88-18419

Plasma confinement calculations for TIBER-2
[DE88-004044] N88-18425

First and second harmonic ECRH experience at gyrotron frequencies at LLNL
[DE88-003998] N88-18430

Stability of an RFP (Reversed-Field Pinch) with resistive and distant boundaries
[DE88-004155] N88-18431

PLASMA CURRENTS

Tokamak with highly elongated cross-section of a plasma
[DE88-700356] N88-18412

PLASMA DENSITY

A study of single and binary ion plasma expansion into laboratory-generated plasma wakes
[NASA-CR-4125] N88-18427

PLASMA DIAGNOSTICS

Overview of applications of Laser-Induced Breakdown Spectroscopy (LIBS)
[DE88-004314] N88-17987

Diagnostics for ATF
[DE88-004175] N88-18438

PLASMA DRIFT

A study of single and binary ion plasma expansion into laboratory-generated plasma wakes
[NASA-CR-4125] N88-18427

PLASMA EQUILIBRIUM

Tokamak with highly elongated cross-section of a plasma
[DE88-700356] N88-18412

PLASMA HEATING

D-3He fuels in a field-reversed configuration
[IPPJ-855] N88-18419

New mode conversion process and overdense plasma heating in the electron cyclotron range of frequencies
[IPPJ-854] N88-18420

ATF experimental plans
[DE88-004177] N88-18439

Laser production and heating of plasma for MHD application
[NASA-TP-2798] N88-18443

PLASMA INTERACTIONS

On the role of the ionization frequency to gyrofrequency ratio in the critical ionization velocity interaction
[TRITA-EPP-86-10] N88-18414

A study of single and binary ion plasma expansion into laboratory-generated plasma wakes
[NASA-CR-4125] N88-18427

PLASMA PHYSICS

Physics modeling support contract
[DE88-004039] N88-17980

Plasma physics design and major specifications of candidate reactors for FER design studies. Conceptual design study of FY86 FER
[DE88-751066] N88-18416

New mode conversion process and overdense plasma heating in the electron cyclotron range of frequencies
[IPPJ-854] N88-18420

Plasma theory and simulation
[DE88-003620] N88-18437

PLASMA SHEATHS

Plasma theory and simulation
[DE88-003620] N88-18437

PLASMA TEMPERATURE

Asymmetric double Langmuir probe for fast and automatic measurements of plasma temperature
[DE88-004773] N88-18436

PLASMAS (PHYSICS)

Optimization of outlet channel of plasma ion source
[DE88-700471] N88-18415

Investigations of stimulated Raman scattering from high density underdense plasmas irradiated by a 0.35 micron laser N88-18421

The numerical simulation of accelerator components
[DE87-011597] N88-18423

The deposition rate dependence of plasma polymerization on the radius of curvature of the substrate
[DE88-003811] N88-18429

Zero temperature quark matter equation of state
[DE88-003408] N88-18496

PLASTIC DEFORMATION

Institute for Materials Science and Engineering, Fracture and Deformation Division: Technical activities, 1987
[PB88-153622] N88-18039

PLASTIC PROPERTIES

Application of inverse gas chromatography to fluidity studies
[DE88-002896] N88-17750

Applications of energy density theory in cyclic plasticity
[AD-A186947] N88-18023

Computed stress and strain distributions under interference fit and after coldworking
[AD-A186950] N88-18024

PLASTICIZERS

NMR (Nuclear Magnetic Resonance) imaging for detecting binder/plasticizers in green-state structural ceramics
[DE88-003111] N88-17800

PLATES

Optimum design of geodesically stiffened composite plates
[NASA-CR-182499] N88-18035

PLATINUM

NBS (National Bureau of Standards) measurement services: Platinum resistance thermometer calibrations
[PB88-138367] N88-17967

Order-disorder transition of Au and Pt (110) surfaces: The significance of relaxations and vibrations
[DE88-004651] N88-18473

PLENUM CHAMBERS

Advanced Technology for Aero Gas Turbine Components
[AGARD-CP-421] N88-17647

Development of a plenum chamber burner system for an advanced VTOL engine N88-17664

PLOTTING

The effects of data structure on total time on test plots
[AD-A187628] N88-18296

POINT DEFECTS

Diffusion studies in amorphous NiZr alloys
[DE88-003009] N88-17781

POISSON EQUATION

Fast Poisson solver on irregular regions by boundary integral-based domain decomposition methods
[DE88-003583] N88-18340

POLAR CAPS

Collaborative studies of polar cap ionospheric dynamics
[AD-A187888] N88-18098

POLAR REGIONS

Collaborative studies of polar cap ionospheric dynamics
[AD-A187888] N88-18098

POLLUTION CONTROL

The role of repowering in America's power generation future
[DOE/FE-0096] N88-18076

POLYCRYSTALS

Adhesion of vapour phase deposited ultra-thin polyimide films on polycrystalline silver
[AD-A187930] N88-17810

POLYIMIDES

Adhesion of vapour phase deposited ultra-thin polyimide films on polycrystalline silver
[AD-A187930] N88-17810

POLYMERIC FILMS

Electrically conducting polymer-copper sulphide composite films, preparation by treatment of polymer-copper (2) acetate composites with hydrogen sulfide
[NASA-TT-20204] N88-17803

Interactions of cultured human endothelial cells with polymeric surfaces
[PB88-112255] N88-18178

POLYMERIZATION

Thermogravimetric analysis of polymeric materials for an intermediate temperature solid electrolyte
[DE88-004854] N88-17809

The deposition rate dependence of plasma polymerization on the radius of curvature of the substrate
[DE88-003811] N88-18429

POLYMETHYL METHACRYLATE

Some aspects of the mechanics and mechanisms of dynamic brittle fracture N88-18028

POLYNOMIALS

Fast and practical parallel polynomial interpolation
[DE88-003530] N88-18328

Polynomial preconditioning for conjugate gradient methods
[DE88-005214] N88-18342

Small degree solutions for the polynomial Bezout equation
[AD-A187630] N88-18355

POLYTETRAFLUOROETHYLENE
An evaluation of effectiveness of PTFE (polytetrafluoroethylene) type friction reducers on reducing friction and wear
[AD-A187440] N88-18010
POLYVINYL FLUORIDE
Piezoelectric laminates for torsional and bending model control: Theory and experiment N88-18029
PORTABLE EQUIPMENT
TABLET: The personal computer of the year 2000
[NASA-CR-182528] N88-18267
POSITION (LOCATION)
Strategic placement of accelerometers to measure forces by the sum of weighted accelerations
[DE88-002262] N88-17968
POSTFLIGHT ANALYSIS
GAS 450: A space payload for the People Central Coast Student Experimenters N88-17709
POSTURE
Effect of antiorthostatic position and different illumination on sensitivity of skin in upper half of the body to ultraviolet radiation N88-18145
Morphological manifestations of primate adaptation to orthograde statics and walking erect N88-18162
POTENTIAL FIELDS
Realistic conductivity geometry model of the human head for interpretation of neuromagnetic data
[PB88-112230] N88-18179
POTENTIAL FLOW
Wall jet analysis for circulation control aerodynamics. Part 2: Zonal modeling concepts for wall jet/potential flow coupling N88-17593
POWDER METALLURGY
Materials development for JPL oxygen plant
[DE88-003067] N88-17752
POWER CONDITIONING
Laboratory evaluation and analysis of advanced lead-acid load-leveling batteries
[DE88-002851] N88-18064
Microwave semiconductor research-materials, devices and circuits
[AD-A187121] N88-18444
POWER LINES
Cape Blanco wind farm feasibility study
[DE88-003749] N88-18060
POWER SPECTRA
Universal power spectra for wave turbulence: Applications to wind waves, flicker noise, solar wind spectrum and classical second sound N88-17879
POWER SUPPLIES
Pulsed current transformer for low inductive loads
[AD-A187224] N88-17913
POWER SUPPLY CIRCUITS
A technique for low level, wide range CW microwave power meter calibrations
[DE88-004147] N88-17966
POWERED LIFT AIRCRAFT
Application of empirical and linear methods to VSTOL powered-lift aerodynamics
[NASA-TM-100048] N88-17581
Development of circulation control technology for powered-lift STOL aircraft N88-17608
A potential flight evaluation of an upper-surface-blowing/circulation-control-wing concept N88-17609
PRE-MAIN SEQUENCE STARS
A spherical, non-LTE, blanketed model stellar atmosphere for Phi Cas (FOIa) N88-18528
PREAMPLIFIERS
On the choice of a element low-noise preamplifier on bipolar transistors
[DE88-700639] N88-17904
Design of a charge sensitive preamplifier on high resistivity silicon
[DE88-003491] N88-17907
Low-noise cryogenically cooled broad-band microwave preamplifiers
[DE88-004561] N88-17912
PRECIPITATION (CHEMISTRY)
Precipitation of surfactants and surfactant mixtures in aqueous solutions
[DE88-003333] N88-17763
PRECIPITATION HARDENING
Micro-mechanisms of deformation in SiC/Al composites
[AD-A188282] N88-17749
PRECISION
CARS measurements of combustion. 1: Precision of thermometry
[NAL-TR-939] N88-17769
On precision and accuracy (bias) statements for measurement procedures
[DE88-004434] N88-18359
PRECONDITIONING
Polynomial preconditioning for conjugate gradient methods
[DE88-005214] N88-18342
Domain decomposition preconditioners for the spectral collocation method
[NASA-CR-181620] N88-18345
PREDICTION ANALYSIS TECHNIQUES
An experimental investigation of pressure driven three-dimensional turbulent boundary layers N88-17934
Forecasting complications of cardiovascular disease in flight personnel N88-18136
PREDICTIONS
Studies of the initiation of pitting corrosion on stainless steels
[AERE-M-3615] N88-17778
A three-dimensional dual potential procedure for rotational flows N88-17942
On the dynamic estimation of relative weights for observation and forecast in numerical weather prediction
[NASA-CR-182531] N88-18106
Future directions in computer architecture N88-18257
Application of a multigrid method to a buoyancy-induced flow problem
[DE88-003961] N88-18326
Linear prediction of stationary vector sequences
[NASA-TM-100069] N88-18366
PREFLIGHT ANALYSIS
Laser investigations for payload G-652 prior to filing pre-flight accommodation requirements N88-17694
PREMIXED FLAMES
Analysis of a turbulent premixed V-flame (influence of flame-thickening)
[NAL-TR-941] N88-17770
PRESSURE DISTRIBUTION
The further development of circulation control airfoils N88-17594
Pressure distributions and oil-flow patterns for a swept circulation-control wing N88-17596
Leeside crossflow modeling in Euler space-marching computations
[NASA-TM-89710] N88-17924
Spatial pressure variations and three-dimensional effects on liquid sloshing loads
[PB88-120134] N88-17926
A component synthesis method using Lanczos vectors
[DE88-002263] N88-18368
PRESSURE EFFECTS
Effects of commercial cladding on the fracture behavior of pressure vessel steel plates
[DE88-004333] N88-17790
Evaluation of spare room in cerebrospinal system using noninvasive methods N88-18137
PRESSURE GRADIENTS
Study of resistive pressure-gradient-driven turbulence
[DE88-005062] N88-18441
PRESSURE ICE
Physical and structural characteristics of Weddell Sea pack ice
[AD-A188189] N88-18119
PRESSURE MEASUREMENT
A reliable data collection/control system N88-17706
Development and application of oxygen flow tagging for velocity measurements and flow visualization in turbulent three-dimensional supersonic flows
[AD-A187982] N88-17714
The use of optical fibers for shock pressure and timing measurements at high pressures
[DE88-004012] N88-17971
Flash threshold of shocked aluminum silicofluoride
[DE88-003978] N88-18005
PRESSURE SENSORS
An integrated pressure sensor for in-vivo use N88-17965
PRESSURE VESSELS
Effects of commercial cladding on the fracture behavior of pressure vessel steel plates
[DE88-004333] N88-17790
Acoustic emission measurements of PWR weld materials with inserted defects
[AERE-R-12386] N88-18016
PRIMATES
Morphological manifestations of primate adaptation to orthograde statics and walking erect N88-18162
PRIMITIVE EQUATIONS
Implicit solution of the incompressible Navier-Stokes equations in primitive variables on non-staggered grids N88-17930
PROBABILITY DISTRIBUTION FUNCTIONS
Dependence of the expectancy of hitting on the number of spread shots. Determination of the expectancy of hitting using a spread salvo
[REPT-FM6] N88-17829
The convergence rate for the strong law of large numbers: General lattice distributions
[AD-A187560] N88-18362
PROBABILITY THEORY
Response of wind shear warning systems to turbulence with implication of nuisance alerts N88-17618
Development of a graphics based two-attribute utility assessment program with application to mission planning
[AD-A187276] N88-18292
Explicit solutions of moment problems, 1
[AD-A186018] N88-18325
Asymptotic expansions for large deviation probabilities in the strong law of large numbers
[AD-A187432] N88-18361
PROBLEM SOLVING
Continuous deformation algorithm on the product space of unit simplices, revised version
[PB88-114210] N88-18281
A visual programming environment for the Navier-Stokes computer
[NASA-CR-181615] N88-18299
Knowledge base refinement by monitoring abstract control knowledge, revision 1
[AD-A187502] N88-18323
Applications of Lie group methods to the equations of magnetohydrodynamics N88-18422
PROCEDURES
Are windshear training aid recommendations appropriate for other than large jet transports? Pilot procedures: Shear models N88-17635
Supercritical fluid extraction-gas chromatography of Volatile Organic Compounds (VOC) from tenax devices
[PB88-124300] N88-17759
Research on a solar biotechnology based on the culture of photosynthetic cells
[DE88-900129] N88-18120
PROCESS CONTROL (INDUSTRY)
Fabrication and materials evaluation of high performance aligned ceramic fibre reinforced glass matrix composite
[AERE-R-12517] N88-17736
PRODUCT DEVELOPMENT
Study for history of technology developments in European space projects
[REPT-8518-1] N88-17690
The intelligent wing. Aerodynamic development direction for future passenger aircraft
[MBB-UT-006/87] N88-17848
Trends in the development of space transportation systems
[MBB-UR-911/86] N88-17857
PRODUCTION PLANNING
Product planning in civil aircraft construction
[MBB-UT-002/87] N88-17849
Viscosity methods in optimal control of distributed systems
[AD-A188086] N88-18357
PROGRAM VERIFICATION (COMPUTERS)
An expert system to support the verification/validation of flight-critical software
[MBB-UT-102/87] N88-17852
A generalized method for automatic downhand and wirefeed control of a welding robot and positioner
[NASA-TP-2807] N88-17869
AEV local verification for aviation, precipitation and temperature programs: AV, REL, TEM (September 1987 revision)
[PB88-115662] N88-18101
PROGRAMMING LANGUAGES
ESL batteries and multi-segment applications --- ESA Simulation Language (ESL)
[CS-1029/00-QFIN4] N88-17901
SISAL: Initial MIMD performance results N88-18208
Predicate analysis for parallel program generation N88-18222
Software support for heterogeneous machines N88-18224
Portable (and disposable) interpreters N88-18237
Programming language translation for multicomputers N88-18244
Finely grained parallelism in an applicative architecture N88-18256
FX-87 reference manual, edition 1.0
[AD-A187031] N88-18273
Graph transformation algorithms for array memory optimization in applicative languages
[DE88-004727] N88-18283
Semantics of EqL
[AD-A188151] N88-18297
PROGRESS
Recent progress in the p and h-p version on the finite element method
[AD-A187254] N88-18347

PROJECT MANAGEMENT
Study for history of technology developments in European space projects
[REPT-8518-1] N88-17690
System analysis study of space platform and station accommodations for life sciences research facilities. Volume 2: Study results. Appendix E: Work breakdown structure and dictionary
[NASA-CR-179274] N88-17723
Project management in astronautics: From Spacelab to Columbus
[MBB-URE-943/87] N88-17858
Coordination: Southeast continental shelf studies
[DE88-003680] N88-18110
PROJECT PLANNING
The 1987 Get Away Special Experimenter's Symposium
[NASA-CP-2500] N88-17691
Planet X probe: A fresh new look at an old familiar place N88-17699
GAS 450: A space payload for the People Central Coast Student Experimenters N88-17709
The NORSTAR Program: Space shuttle to space station N88-17710
System analysis study of space platform and station accommodations for life sciences research facilities. Volume 2: Study results. Appendix E: Work breakdown structure and dictionary
[NASA-CR-179274] N88-17723
Coordination: Southeast continental shelf studies
[DE88-003680] N88-18110
Development of a graphics based two-attribute utility assessment program with application to mission planning
[AD-A187276] N88-18292
PROJECTILES
Investigation of several spread shot conditions
[REPT-TR-164] N88-17830
PROLOG (PROGRAMMING LANGUAGE)
Experimenting with parallel programing in logic N88-18240
PROP-FAN TECHNOLOGY
Analysis of possible transmission arrangements applicable for driving single or twin counterrotating fans on propfan engines N88-17670
Vibration and flutter characteristics of the SR7L large-scale propfan
[NASA-TM-100272] N88-18036
PROPANE
Gas hydrate model development and validation
[DE88-001004] N88-17762
Geological evolution and analysis of confirmed or suspected gas hydrate localities. Volume 9: Formation and stability of gas hydrates of the Middle America Trench
[DE88-001007] N88-18050
PROPELLANT COMBUSTION
Shuttle rocket booster computational fluid dynamics
[NASA-CR-182518] N88-17733
PROPELLANT DECOMPOSITION
The chemistry of the hypochlorite neutralization of hydrazine fuels
[DE88-002971] N88-17812
PROPELLANT SENSITIVITY
An infra-red investigation of HAN (Hydroxylammonium Nitrate)-based liquid propellants
[AD-A187226] N88-17815
PROPELLER BLADES
Numerical methods for propeller aerodynamics and acoustics at DFVLR N88-17668
PROPELLER EFFICIENCY
Numerical methods for propeller aerodynamics and acoustics at DFVLR N88-17668
PROPELLER FANS
Analysis of possible transmission arrangements applicable for driving single or twin counterrotating fans on propfan engines N88-17670
PROPELLERS
Lifting-surface theory of oscillating propellers in compressible flow
[NAL-TR-943] N88-17613
Aerodynamic performance of a scale-model, counter-rotating unducted fan N88-17666
Numerical methods for propeller aerodynamics and acoustics at DFVLR N88-17668
Analysis of highspeed propellers aerodynamics N88-17669
PROPRIOCEPTION
Perception and control of simulated self motion
[AD-A187444] N88-18188
PROPRIOCEPTORS
Role of optokinetic stimulation in vestibulospinal reflexes N88-18131
PROPULSION SYSTEM CONFIGURATIONS
Calculation and design of a ramjet missile
[REPT-TR-500] N88-17832
The MBB propulsion concepts for magnetic suspension railways: Retrospective view and prospects
[MBB-Z-141/87] N88-17865
PROPULSIVE EFFICIENCY
Gear systems for advanced turboprops N88-17667
PROTECTIVE COATINGS
Bias, internal stress and substrate effects on the microstructure and properties of PVD-wear resistant coatings
[AERE-R-12360] N88-17798
The soft/hard wet anodization of aluminum oxide and its use in a thin film multilayered capacitor
[AD-A187575] N88-17919
PROTEINS
Protein-crystal growth experiment (planned) N88-17700
PROTONS
An analytic model for ionization distributions produced in nanometer sites by protons
[DE88-003943] N88-18385
PROTOTYPES
Shared workspaces for real-time collaboration in distributed networks: Concepts, techniques, problems
[AD-A188150] N88-18315
PROVING
Simulation test beds for the space station electrical power system
[NASA-TM-100786] N88-17715
Formal multilevel hierarchical verification of synchronous MOS VLSI circuits
[AD-A187532] N88-17918
Navigation recovery block design description
[NASA-CR-182473] N88-18022
Benchmark computation and finite element performance evaluation for a rhombic plate bending problem
[AD-A187402] N88-18041
Automated data flow diagram verification N88-18255
PROXIMITY EFFECT (ELECTRICITY)
The effect of magnetic impurities and barriers on the magnetization and critical current of fine filament NbTi composites
[DE88-004443] N88-18472
PSYCHOLOGICAL EFFECTS
Medical and psychological problems of assuring flight safety under present conditions N88-18123
Investigation of effects of short-term exposure to high concentrations of carbon monoxide on operator's psychophysiological functions N88-18133
PSYCHOLOGY
Innovation and creativity: A critical linkage
[DE88-003309] N88-18515
PSYCHOPHYSICS
Perception and control of simulated self motion
[AD-A187444] N88-18188
PULSARS
The formation of single millisecond pulsars in globular clusters
[MPE-PREPRINT-97] N88-18525
PULSE DURATION
Laser pulse width dependent surface ripples on silicon
[PB88-127311] N88-17982
PULSED LASERS
Calculation of the spatial-temporal deformation of laser pulses in multiple scattering
[MBB-Z-111/87] N88-17837
Monitoring interfacial dynamics by pulsed laser techniques
[DE88-003362] N88-17976
Laser pulse width dependent surface ripples on silicon
[PB88-127311] N88-17982
Overview of applications of Laser-Induced Breakdown Spectroscopy (LIBS)
[DE88-004314] N88-17987
Optically controlled devices and ultrafast laser sources for signal processing
[AD-A187417] N88-17995
PULSED RADIATION
Advanced energy conversion concept for beamed-energy propulsion
[AD-A187336] N88-17914
PULSES
Gas phase pulse radiolysis
[DE88-002981] N88-17751
The 80 fsec soliton-like pulses from an optical-nonlinear fiber resonator
[PB88-127303] N88-18403
PUMPS
Materials development for JPL oxygen plant
[DE88-003067] N88-17752

Q

QUALIFICATIONS
Qualification of frequency response functions using the rigid-body response
[DE88-000745] N88-18033
QUALITY CONTROL
Training guidelines in non-destructive testing techniques
[DE88-700613] N88-18019
Analysis and application of the constant tensile load test for polyethylene gas pipe materials
[DE88-002868] N88-18037
A method for assessing the software engineering capability of contractors: Preliminary version
[AD-A187230] N88-18290
QUANTILES
A generalized quantile estimator under censoring
[AD-A188280] N88-18364
QUANTUM CHROMODYNAMICS
Status of the electroweak theory
[DE88-002342] N88-18494
QUANTUM EFFICIENCY
Performance of a photon counting microchannel plate intensifier with wedge and strip image readout
[DE88-003831] N88-17970
QUANTUM ELECTRONICS
Microwave semiconductor research-materials, devices and circuits
[AD-A187121] N88-18444
QUANTUM MECHANICS
An overview of the transactional interpretation of quantum mechanics
[DE88-004236] N88-18497
Fundamental properties of spin-polarized quantum systems
[DE88-004425] N88-18499
QUANTUM THEORY
Study of quantum mechanical effects in deep submicron, grating-gate field effect transistors
[AD-A188283] N88-17923
Antimatter: Its history and its properties
[DE88-004308] N88-18498
QUARKS
Zero temperature quark matter equation of state
[DE88-003408] N88-18496
Hadron-quark phase transition in dense stars
[DE88-003412] N88-18532
Quark matter in astrophysics and cosmology
[DE88-003406] N88-18534
QUARTZ
The use of optical fibers for shock pressure and timing measurements at high pressures
[DE88-004012] N88-17971
QUERY LANGUAGES
Distributed query processing: Present status and future direction N88-18219
QUEUEING THEORY
A queueing system with independent Markov input streams
[AD-A187601] N88-18363

R

RADAR
Wind shear radar simulation N88-17625
RADAR DETECTION
Airborne Doppler radar technology for wind shear detection N88-17622
Experiments for the high resolution detection of moving targets using a CO2 laser radar
[MBB-UA-1044/87] N88-17864
RADAR ECHOES
SAR (Synthetic Aperture Radar) imaging of ship wakes in the Gulf of Alaska
[AD-A186554] N88-17872
RADAR IMAGERY
SAR (Synthetic Aperture Radar) imaging of ship wakes in the Gulf of Alaska
[AD-A186554] N88-17872
Radar reflectivity and attenuation of radio waves in the melting layer of precipitation
[PB88-121553] N88-17882
RADAR SCATTERING
Radar returns from ground clutter in vicinity of airports N88-17624
RADAR TARGETS
Detection of signals in non-Gaussian correlated noise derived from Cauchy processes
[AD-A187488] N88-17894
RADIATION DAMAGE
Irradiation effects in metals
[DE88-004272] N88-17789

Suppression of X-rays generated by runaway electrons in ATF
[DE88-004179] N88-18440

RADIATION DETECTORS
Evaluation of surface energy and radiation balance systems on the Konza Prairie
[NASA-CR-182534] N88-18097

RADIATION DISTRIBUTION
Time domain wave propagation in multilayered integrated circuits
[AD-A187462] N88-17916

RADIATION DOSAGE
Effects of the neutron spectrum on mechanical property changes in low dose irradiations
[DE88-003429] N88-17786
International cooperative effort to establish ASTM (American Society for Testing and Materials) standards for the measurement of radiation dose for food processing
[DE88-002702] N88-18190

RADIATION EFFECTS
JPRS Report: Science and Technology. USSR: Space Biology and Aerospace Medicine, volume 21, no. 5, September - October 1987
[JPRS-USB-88-003] N88-18122
Short- and long-term effects of nonlethal levels of fast high-energy helium ions on retention of developed and formation of new behavioral patterns in rats N88-18140
Effect of antiorthostatic position and different illumination on sensitivity of skin in upper half of the body to ultraviolet radiation N88-18145
Effect of spaceflight factors on biological material flown aboard Cosmos-1514 biosatellite N88-18154
Combined effect of ionizing radiation and altered gas atmosphere on central nervous system N88-18168

RADIATION MEASUREMENT
International cooperative effort to establish ASTM (American Society for Testing and Materials) standards for the measurement of radiation dose for food processing
[DE88-002702] N88-18190

RADIATION SHIELDING
Suppression of X-rays generated by runaway electrons in ATF
[DE88-004179] N88-18440

RADIATION SOURCES
On the time delay of the ultrahigh-energy radiation signal from the source Cygnus X-3
[DE88-700649] N88-18547

RADIATIVE TRANSFER
Parameterization of radiative transfer in the Earth's atmosphere with specific applications to clouds N88-18087
Light absorption by an atom moving inside a spherical box
[AD-A187241] N88-18395

RADII
The deposition rate dependence of plasma polymerization on the radius of curvature of the substrate
[DE88-003811] N88-18429

RADIO ANTENNAS
Capacitor analysis for RF antennas
[DE88-004178] N88-17883

RADIO EQUIPMENT
MARCE data evaluation N88-17693

RADIO TELEMETRY
A deep-water OBS (Ocean Bottom Seismometer) array with real-time telemetry
[AD-A187404] N88-18112

RADIO TRANSMISSION
MARCE data evaluation N88-17693
User's guide for the HF (High Frequency) broadcast antenna design and validation summary programs
[PB88-116124] N88-17875

RADIO WAVES
Radar reflectivity and attenuation of radio waves in the melting layer of precipitation
[PB88-121553] N88-17882

RADIOACTIVE DECAY
Calculated late time spectra of supernovae
[DE88-003296] N88-18530
A look at Supernova 1987A
[DE88-003411] N88-18531

RADIOACTIVITY
Measurements of astrophysical reaction rates for radioactive samples
[DE88-004309] N88-18537

RADIOGRAPHY
Durability and damage tolerance of aluminum castings
[AD-A186444] N88-18013
Institute for Materials Science and Engineering, nondestructive evaluation: Technical activities 1987
[PB88-153655] N88-18020

RADIOLYSIS
Gas phase pulse radiolysis
[DE88-002981] N88-17751
Electron transfer to iron(3) oxide colloids
[DE88-002885] N88-18448

RAIL TRANSPORTATION
Composite materials for rail transit systems
[NASA-CR-178401] N88-17738
The MBB propulsion concepts for magnetic suspension railways: Retrospective view and prospects
[MBB-Z-141/87] N88-17865

RAILGUN ACCELERATORS
Pulsed current transformer for low inductive loads
[AD-A187224] N88-17913

RAILS
Composite materials for rail transit systems
[NASA-CR-178401] N88-17738

RAIN
The structure and dynamics of monsoon depressions N88-18102

RAMAN SPECTRA
Application of state-multipole Heisenberg equations to Raman excitation dynamics
[DE88-003828] N88-17977
Investigations of stimulated Raman scattering from high density underdense plasmas irradiated by a 0.35 micron laser N88-18421

RAMAN SPECTROSCOPY
CARS measurements of combustion. 1: Precision of thermometry
[NAL-TR-939] N88-17769

RAMJET MISSILES
Calculation and design of a ramjet missile
[REPT-TR-500] N88-17832

RANDOM LOADS
Fatigue crack growth due to random loading
[DE88-004641] N88-18038

RANDOM PROCESSES
Electronic structure of random alloys and the theory of ordering processes
[DE88-004476] N88-18394

RANDOM VARIABLES
Explicit solutions of moment problems, 1
[AD-A186018] N88-18325

RANKINE CYCLE
An experiment to investigate Rankine cycle two-phase microgravity issues
[DE88-004197] N88-17818

RARE EARTH COMPOUNDS
Superconductivity and phase stability in the heavy rare earth quaternary compounds RBa2Cu3O7 (R = Ho, Er, Tm, Yb, Lu)
[DE88-003478] N88-18476

RATES (PER TIME)
The effects of data structure on total time on test plots
[AD-A187628] N88-18296
The convergence rate for the strong law of large numbers: General lattice distributions
[AD-A187560] N88-18362

RATIOS
On the role of the ionization frequency to gyrofrequency ratio in the critical ionization velocity interaction
[TRITA-EPP-86-10] N88-18414

RATS
Histomorphometric analysis of rat bones after spaceflight aboard Cosmos-1667 biosatellite N88-18128
Effect of weightlessness on replicative function of rat hepatocyte DNA N88-18129
RNA-synthesizing activity in rat liver following flight aboard Cosmos-1667 N88-18130
Short- and long-term effects of nonlethal levels of fast high-energy helium ions on retention of developed and formation of new behavioral patterns in rats N88-18140
Myosin Ca sup (2+), Mg sup (2+)-adenosine triphosphatase activity in ray myocardium following 30-day expose to 1.1 and 2.0 G N88-18141
Kinetic toxic aspect of potential use of sulfur hexafluoride in closed environments N88-18142
Comparative evaluation of stress repsonse of rats to different methods of simulating some effects of weightlessness N88-18144
Experimental measurements of the uptake of ozone in rats and human subjects
[PB88-125422] N88-18149
Investigation of genetic structures of rat germ cells following flight aboard Cosmos-1514 biosatellite during their prenatal development N88-18155
Morphological and functional state of the hypothalamo-hypophyseal neurosecretory system of rats flown aboard Cosmos-1667 N88-18156
Investigation of rat skeletal muscles following short-term spaceflight aboard Cosmos-1667 biosatellite N88-18157
Morphological study of early changes in rat bones in simulated weightlessness N88-18158
Lipid peroxidation in rat tissues with exposure to antiorthostatic hypokinesia, exercise and immobilization stress N88-18159
Effect of cardioactive compounds on rat myocardium actomyosin following exposure to accelerations N88-18161
Effect of external electrostatic field on catecholamine secretion by rat adrenals N88-18166
New book on metabolic aspects of spaceflight stress N88-18172
Scaling physiological pharmacokinetic models by physiological time
[DE88-000335] N88-18173

RAWINSONDES
Minimum Energy Routing through Interactive Techniques (MERIT) modeling
[NASA-CR-182535] N88-18105

RAYLEIGH NUMBER
Periodic natural convection in a rectangular enclosure of low aspect ratio N88-17941

REACTION KINETICS
Insights into the mechanisms of chemical reactions: Reaction paths for chemical reactions
[DE88-003041] N88-17755
Flame propagation in the approximation of straight-line trajectories of burning products
[DE88-700675] N88-17756
Diffusion description of flame propagation due to the translational motion of burning reaction products
[DE88-700676] N88-17757
Low temperature reactivity of chars towards oxygen, appendix E2
[DE88-004088] N88-17760
Kinetic studies following state-selective laser excitation
[DE88-004094] N88-17981
Chemical activation of molecules by metals: Experimental studies of electron distributions and bonding
[DE88-004465] N88-18393
Measurements of astrophysical reaction rates for radioactive samples
[DE88-004309] N88-18537

REACTION TIME
A deep-water OBS (Ocean Bottom Seismometer) array with real-time telemetry
[AD-A187404] N88-18112

REACTIVITY
Low temperature reactivity of chars towards oxygen, appendix E2
[DE88-004088] N88-17760
Local stoichiometry and atomic interdiffusion during reactive metal/mercury-cadmium-telluride junction formation
[AD-A187554] N88-18488
Nonmonotonic evolution and thermodynamic trends at metal/(Hg,Cd)Te interfaces: Yb/Hg0.78Cd0.22Te
[AD-A187591] N88-18490

REACTOR CORES
Mechanistic model for void distribution in flashing flow
[DE88-002948] N88-17928

REACTOR DESIGN
A solar receiver-reactor with specularly reflecting walls for high-temperature thermoelectrochemical and thermochemical processes
[AD-A187612] N88-18077
Plasma physics design and major specifications of candidate reactors for FER design studies. Conceptual design study of FY86 FER
[DE88-751066] N88-18416
Development of tokamak reactor system analysis code NEW-TORSAC
[DE88-751067] N88-18417
Conceptual design study of Fusion Experimental Reactor (FY86 FER): Safety
[DE88-751071] N88-18418
Design issues for a laboratory high gain fusion facility
[DE88-004406] N88-18434

REACTOR MATERIALS
Mechanisms of intergranular attack and stress corrosion cracking of alloy 600 by high-temperature caustic solutions containing impurities
[DE87-012820] N88-17773

REACTOR SAFETY
Design issues for a laboratory high gain fusion facility
[DE88-004406] N88-18434

READOUT
Performance of a photon counting microchannel plate intensifier with wedge and strip image readout
[DE88-003831] N88-17970

REAL GASES
Hypersonic blunt body computations including real gas effects
[NASA-TM-100074] N88-18344

REAL NUMBERS
Explicit solutions of moment problems, 1
[AD-A186018] N88-18325
REAL TIME OPERATION
Investigation of real-time two-dimensional visualization of fuel spray liquid/vapor distribution via exciplex fluorescence
[AD-A188268] N88-17816
A smart, mapping, charting and geodesy control generator, phase 1
[AD-A186184] N88-18055
A deep-water OBS (Ocean Bottom Seismometer) array with real-time telemetry
[AD-A187404] N88-18112
Real time artificial intelligence architecture N88-18242
Parallelism at the microlevel: Cooperative microcontrollers with real time considerations N88-18246
Future directions in computer architecture N88-18257
Shared workspaces for real-time collaboration in distributed networks: Concepts, techniques, problems
[AD-A188150] N88-18315
RECEIVERS
Remote sensing of atmospheric crosswinds by utilizing speckle-turbulence interaction and optical heterodyne detection
[AD-A187580] N88-18052
A solar receiver-reactor with specularly reflecting walls for high-temperature thermoelectrochemical and thermochemical processes
[AD-A187612] N88-18077
A deep-water OBS (Ocean Bottom Seismometer) array with real-time telemetry
[AD-A187404] N88-18112
RECIPROCITY THEOREM
Time-domain reciprocity theorems for electromagnetic fields in dispersive media
[PB88-126925] N88-17886
RECOGNITION
Windshear training aid. Volume 1: Overview, pilot guide, training program
[PB88-127196] N88-17637
RECORDING
Digital imaging techniques for single- and multi-phase reacting flowfields N88-17933
RECOVERABILITY
Navigation recovery block design description
[NASA-CR-182473] N88-18022
RECRYSTALLIZATION
Dynamic recrystallization during high temperature low cycle fatigue of nickel
[DE88-003224] N88-17788
RECURSIVE FUNCTIONS
Recursive forward dynamics for multiple robot arms moving a common task object
[NASA-CR-182526] N88-18008
Dynamic observers as asymptotic limits of recursive filters: Special cases
[AD-A187578] N88-18324
RECYCLING
Evaluation of bituminous materials used in pavement recycling projects at Tyndall, MacDill, and Hurlburt Air Force Bases
[AD-A188068] N88-17871
REDUCED GRAVITY
Microgravity research at the University of Mexico: Experiments in payload G-006 N88-17692
Ten past and ten future GAS/MAUS-payloads N88-17696
An update to the MITRE/WPI Space Shuttle Program GASCAN G-408 N88-17697
Electrochemical growth of linear conducting crystals in microgravity N88-17698
Protein-crystal growth experiment (planned) N88-17700
A payload for investigating the influence of convection on GaAs crystal growth N88-17702
Application of Hoffman modulation contrast microscopy coupled with three-wavelength two-beam interferometry to the in situ direct observation of the growth process of a crystal in microgravity N88-17704
The challenge of G-376 N88-17705
A reliable data collection/control system N88-17708
GAS 450: A space payload for the People Central Coast Student Experimenters N88-17709
Results from the melting of tungsten composites under microgravity (Texus 10 flight)
[PB88-128236] N88-17817
An experiment to investigate Rankine cycle two-phase microgravity issues
[DE88-004197] N88-17818
NASA Workshop on Biological Adaptation
[NASA-TM-89468] N88-18174
Non-proprietary research projects of the Center for the Space Processing of Engineering Materials
[AR-2] N88-18516
REENTRY TRAJECTORIES
Maneuverable reentry vehicle trajectory footprints: Calculation and properties
[DE88-004726] N88-17726
REFINING
High-density jet fuels from coal syncrudes, appendix 4
[DE88-003132] N88-17813
Knowledge base refinement by monitoring abstract control knowledge, revision 1
[AD-A187502] N88-18323
REFLECTANCE
Radar reflectivity and attenuation of radio waves in the melting layer of precipitation
[PB88-121553] N88-17882
Improved canopy reflectance modeling and scene inference through improved understanding of scene pattern
[NASA-CR-182488] N88-18049
Optical measurements of surface oxide layer formation on metal films
[DE88-003163] N88-18405
REFRACTIVITY
The stability of free-electron lasers against filamentation
[DE88-004712] N88-18435
REGISTERS
Vector performance of register-to-register vector computers
[DE88-004013] N88-18265
REGULATORY MECHANISMS (BIOLOGY)
NASA Workshop on Biological Adaptation
[NASA-TM-89468] N88-18174
REINFORCED PLASTICS
Short fiber reinforced thermoplastic composites for armor applications: Interfacial bonding
[DE88-004007] N88-17742
REINFORCING FIBERS
Short fiber reinforced thermoplastic composites for armor applications: Interfacial bonding
[DE88-004007] N88-17742
REINFORCING MATERIALS
Fabrication and materials evaluation of high performance aligned ceramic fibre reinforced glass matrix composite
[AERE-R-12517] N88-17736
RELATIVISTIC THEORY
Hamiltonian approach to relativistic theory of gravity and to general relativity theory
[DE88-700404] N88-18492
RELATIVITY
On higher derivative gravity
[DE88-700619] N88-18090
Hamiltonian approach to relativistic theory of gravity and to general relativity theory
[DE88-700404] N88-18492
Antimatter: Its history and its properties
[DE88-004308] N88-18498
Velocity reversal and the arrows of time
[DE88-004237] N88-18536
RELIABILITY
Johnson noise thermometer for high radiation and high temperature environments
[DE88-003770] N88-17911
Analysis and application of the constant tensile load test for polyethylene gas pipe materials
[DE88-002668] N88-18037
RELIABILITY ANALYSIS
An anlysis of the reliability of tree-structured interconnection networks N88-18228
REMOTE SENSING
Infrared low-level wind shear work N88-17628
NROSS (Navy Remote Ocean Sensing System): A force multiplier
[AD-A186853] N88-18045
Space-based remote sensing of the Earth: A report to the Congress
[NASA-TM-89709] N88-18046
Earth resources: A continuing bibliography with indexes (supplement 56)
[NASA-SP-7041(56)] N88-18051
Remote sensing of atmospheric crosswinds by utilizing speckle-turbulence interaction and optical heterodyne detection
[AD-A187580] N88-18052
Evaluation of a temperature remote sensing technique
[AD-A187885] N88-18053
Analysis of quasi-geostrophic forcing during the AIMCS (Airborne Investigations of Mesoscale Convective Systems) Project. Volume 2: Results for June 14 through July 16, 1984
[PB88-123807] N88-18092
Coordination: Southeast continental shelf studies
[DE88-003680] N88-18110
REPLENISHMENT
Study of helium transfer technology for STICCR: Fluid management
[NASA-CR-177463] N88-17720
REQUIREMENTS
Crew interface with windshear systems N88-17631
Helicopter external vision requirements and visual display characteristics: A report/bibliography, revision A
[AD-A187075] N88-17641
Specification of an engine and its components starting from a consideration of aircraft missions N88-17651
An integrated aero/mechanical performance approach to high technology turbine design N88-17657
A framework for evaluating computer architectures to support systems with security requirements, with applications
[AD-A187082] N88-18303
RESEARCH
Earth materials research: Report of a Workshop on Physics and Chemistry of Earth Materials
[NASA-CR-182519] N88-17761
Interdisciplinary research in mathematics, science and technology education
[PB88-131446] N88-18333
RESEARCH AND DEVELOPMENT
Director of R and D institutions (Government of India)
[PB88-127162] N88-17685
Research and development. Technical-scientific publications (1956-1987): Retrospective view and prospects. Jubilee edition on the occasion of the 75th birthday of Dipl.-Engr. Dr.-Engr. E. H. Ludwig Boelkow
[ISSN-0931-9751] N88-17819
Research, development, and growth strategy N88-17820
Research and technology 1987 annual report of the Kennedy Space Center
[NASA-TM-100303] N88-18548
RESEARCH FACILITIES
Director of R and D institutions (Government of India)
[PB88-127162] N88-17685
System analysis study of space platform and station accommodations for life sciences research facilities. Volume 1: Executive summary. Phase A: Conceptual design and programmatics
[NASA-CR-179268] N88-17721
System analysis study of space platform and station accommodations for life sciences research facilities. Volume 2: Study results, attachment 2. Phase A: Conceptual design and programmatics
[NASA-CR-179272] N88-17722
Relationships between coronary heart disease risk factors and serum ionized calcium in Kennedy Space Center Cohort
[NASA-TM-100979] N88-18177
Design issues for a laboratory high gain fusion facility
[DE88-004406] N88-18434
Research and technology 1987 annual report of the Kennedy Space Center
[NASA-TM-100303] N88-18548
RESEARCH MANAGEMENT
X-29A forward-swept-wing flight research program status
[NASA-TM-100413] N88-17644
Study for history of technology developments in European space projects
[REPT-8518-1] N88-17690
Research, development, and growth strategy N88-17820
Research studies on extreme ultraviolet and soft X-ray lasers
[AD-A187506] N88-17996
Features of a TeraFlop supercomputer
[DE88-003540] N88-18263
Research in experimental nuclear physics
[DE88-004100] N88-18397
Innovative arrangements for industry/DOE laboratory collaboration in high temperature superconductivity
[DE88-004320] N88-18482
Journal of Research of the National Bureau of Standards, volume 92, number 5, September-October 1987
[PB88-124409] N88-18518
Journal of Research of the National Bureau of Standards, volume 92, number 6, November-December 1987
[PB88-138516] N88-18519
RESIDENTIAL ENERGY
Effect of storage thermal behavior in seasonal storage solar heating systems
[PB88-114236] N88-18067
RESIDUAL STRESS
Bias, internal stress and substrate effects on the microstructure and properties of PVD-wear resistant coatings
[AERE-R-12360] N88-17798

RESIN MATRIX COMPOSITES
Mechanics of composite materials: Past, present and future
[NASA-TM-100793] N88-17744
RESISTANCE THERMOMETERS
NBS (National Bureau of Standards) measurement services: Platinum resistance thermometer calibrations
[PB88-138367] N88-17967
RESISTOJET ENGINES
Magnetic emissions testing of the space station engineering model resistojet
[NASA-TM-100788] N88-17728
Component data base for space station resistojet auxiliary propulsion
[NASA-CR-180834] N88-17731
RESONANT FREQUENCIES
Using frequency-domain methods to identify XV-15 aeroelastic modes
[NASA-TM-100033] N88-17646
Time domain wave propagation in multilayered integrated circuits
[AD-A187462] N88-17916
RESOURCES MANAGEMENT
Air Force geographic information and analysis system
[DE88-001420] N88-18505
Computer-Aided Design Information System (CADIS): User's manual
[DE88-004365] N88-18509
RESPIRATION
Experimental measurements of the uptake of ozone in rats and human subjects
[PB88-125422] N88-18149
Effect of oxygen inhalation on respiratory function during exercise and exposure to added resistance to respiration N88-18164
RESPIRATORY SYSTEM
JPRS Report: Science and Technology. USSR: Space Biology and Aerospace Medicine, volume 21, no. 6, November - December 1987
[JPRS-USB-88-004] N88-18150
Effect of hypercapnic-hypoxic test on cariorespiratory parameters of individuals with neurocirculatory dystonia N88-18169
Modeling of the non-auditory response to blast overpressure
[AD-A187397] N88-18184
RESPONSE TIME (COMPUTERS)
Graph transformation algorithms for array memory optimization in applicative languages
[DE88-004727] N88-18283
RESPONSES
Corrosion behavior of sputter-deposited aluminum-based alloys exposed to chloride solutions
[AD-A187262] N88-17794
RETENTION (PSYCHOLOGY)
Short- and long-term effects of nonlethal levels of fast high-energy helium ions on retention of developed and formation of new behavioral patterns in rats N88-18140
REUSABLE LAUNCH VEHICLES
Ballistic Single Stage Carrier Vehicle (BETA): A single stage reusable ballistic space shuttle concept
[MBB-UR-949/70] N88-17828
REUSABLE SPACECRAFT
Ballistic Single Stage Carrier Vehicle (BETA): A single stage reusable ballistic space shuttle concept
[MBB-UR-949/70] N88-17828
Trends in the development of space transportation systems
[MBB-UR-911/86] N88-17857
Three-dimensional Euler solutions for hypersonic Mach numbers
[MBB-UR-944/87] N88-17859
REVERBERATION CHAMBERS
Measurement of shielding effectiveness of different cable and shielding configurations by mode-stirred techniques
[PB88-155791] N88-17885
REVERSE FIELD PINCH
D-3He fuels in a field-reversed configuration
[IPPJ-855] N88-18419
Stability of an RFP (Reversed-Field Pinch) with resistive and distant boundaries
[DE88-004155] N88-18431
Zero-dimensional model of a reversed field pinch fusion reactor
[DE88-005213] N88-18442
REYNOLDS NUMBER
Instability and transition in curved channel flow N88-17938
RHENIUM
Johnson noise thermometer for high radiation and high temperature environments
[DE88-003770] N88-17911
RHENIUM ISOTOPES
A nuclear structure study of the proposed gamma-ray laser candidate nucleus Re-186
[DE88-004299] N88-17986
RHEOLOGY
Thermoplastic elastomers as LOVA binders
[AD-A186563] N88-17797
RHOMBOIDS
Benchmark computation and finite element performance evaluation for a rhombic plate bending problem
[AD-A187402] N88-18041
RIBONUCLEIC ACIDS
RNA-synthesizing activity in rat liver following flight aboard Cosmos-1667 N88-18130
RIGID STRUCTURES
Formulation methods of rigid multibody systems for large space structures and some results of computer simulation
[NAL-TR-942] N88-17730
The dynamics of two coupled rigid bodies
[AD-A187592] N88-18012
Qualification of frequency response functions using the rigid-body response
[DE88-000745] N88-18033
The dynamics of coupled planar rigid bodies. Part 1: Reduction, equilibria and stability
[AD-A187467] N88-18042
RIPPLES
Laser pulse width dependent surface ripples on silicon
[PB88-127311] N88-17982
RISK
Medical and psychological problems of assuring flight safety under present conditions N88-18123
Modeling of the non-auditory response to blast overpressure
[AD-A187397] N88-18184
ROBOTICS
A generalized method for automatic downhand and wirefeed control of a welding robot and positioner
[NASA-TP-2807] N88-17869
NASA/NBS (National Aeronautics and Space Administration/National Bureau of Standards) standard reference model for Telerobot Control System Architecture (NASREM)
[PB88-124773] N88-17999
Design conditions and workspace for the generally-proportioned 3-hinge spherical wrist for robots N88-18003
Recursive forward dynamics for multiple robot arms moving a common task object
[NASA-CR-182526] N88-18008
Parameter identification and sensitivity analysis for a robotic manipulator arm
[NASA-CR-181608] N88-18272
ROBOTS
A generalized method for automatic downhand and wirefeed control of a welding robot and positioner
[NASA-TP-2807] N88-17869
Design conditions and workspace for the generally-proportioned 3-hinge spherical wrist for robots N88-18003
Parameter identification and sensitivity analysis for a robotic manipulator arm
[NASA-CR-181608] N88-18272
ROBUSTNESS (MATHEMATICS)
An integrated pressure sensor for in-vivo use N88-17965
Stable, robust tracking by sliding mode control
[AD-A188278] N88-18358
ROCKET ENGINE DESIGN
Arcjet thruster research and technology
[NASA-CR-180865] N88-17732
ROCKET OXIDIZERS
The chemistry of the hypochlorite neutralization of hydrazine fuels
[DE88-002971] N88-17812
ROLLER BEARINGS
Ceramic bearings for use in gas turbine engines
[NASA-TM-100288] N88-18007
ROOT-MEAN-SQUARE ERRORS
Response of wind shear warning systems to turbulence with implication of nuisance alerts N88-17618
ROSS ICE SHELF
Ice-shelf response to ice-stream discharge fluctuation. Part 1: Unconfined ice tongues
[AD-A188147] N88-18117
ROTARY WING AIRCRAFT
Helicopter external vision requirements and visual display characteristics: A report/bibliography, revision A
[AD-A187075] N88-17641
Rotorcraft weight trends in light of structural material characteristics
[AD-A186576] N88-17642
ROTATION
Design conditions and workspace for the generally-proportioned 3-hinge spherical wrist for robots N88-18003
ROTOR AERODYNAMICS
Frequency-response identification of XV-15 tilt-rotor aircraft dynamics N88-17643
Special flight mechanical features of the bearingless helicopter rotor
[MBB-FM-315/O] N88-17825
ROTOR BLADES
Design and test of a high blade speed, high work capacity transonic turbine N88-17658
Experimental investigation of a supercritical compressor rotor blade section N88-17680
ROTOR BLADES (TURBOMACHINERY)
Three-dimensional incompressible flowfield analysis for establishing rotor designs which optimize power extraction N88-17943
ROTOR SPEED
Study on a rotor speed control system for a horizontal axis windmill
[NAL-TR-931] N88-18062
ROTORS
The further development of circulation control airfoils N88-17594
A research program on the aerodynamics of a highly loaded turbine stage N88-17655
The unsteady gas flow through stator and rotor of a turbomachine N88-17660
Optimal design and parameter identification of flexible rotor-bearing systems N88-18002
ROUTES
Minimum Energy Routing through Interactive Techniques (MERIT) modeling
[NASA-CR-182535] N88-18105
RUBBER
Basic research on macromolecular dynamics
[PB88-141643] N88-17805
RULES
A rule-based Lisp dialect translator using paramodulation N88-18238
RUNWAYS
Evaluation of bituminous materials used in pavement recycling projects at Tyndall, MacDill, and Hurlburt Air Force Bases
[AD-A188068] N88-17871
RUTHENIUM
Growth and electronic properties of strained metal overlayers
[DE87-010958] N88-18463

S

SAFETY MANAGEMENT
Environmental projects. Volume 4: Asbestos survey
[NASA-CR-182527] N88-18083
Conceptual design study of Fusion Experimental Reactor (FY86 FER): Safety
[DE88-751071] N88-18418
SALT SPRAY TESTS
Corrosion behavior of sputter-deposited aluminum-based alloys exposed to chloride solutions
[AD-A187262] N88-17794
SALYUT SPACE STATION
Basic results of medical studies during prolonged manned flights on-board the Salyut-7/Soyuz-T orbital complex
[NASA-TT-20217] N88-18182
SAMPLING
The accommodative status in the dark of US Navy fighter pilots
[AD-A188188] N88-18186
Using SIR (Scientific Information Retrival) system for data management during a field program
[DE88-001555] N88-18508
SATELLITE ATTITUDE CONTROL
Preliminary design of the ORION attitude control system
[AD-A187179] N88-17729
SATELLITE COMMUNICATION
Complementary satellite sound broadcasting systems: A NASA assessment for the Voice of America
[NASA-TM-100300] N88-17899
SATELLITE DESIGN
Lightsats and their attraction to budget oriented Federal agencies N88-17711
Into the thermosphere: The atmosphere explorers
[NASA-SP-490] N88-18084
SATELLITE IMAGERY
Inexpensive solution for the mass distribution of satellite images
[PB88-114038] N88-17873

Analysis of quasi-geostrophic forcing during the AIMCS (Airborne Investigations of Mesoscale Convective Systems) Project. Volume 2: Results for June 14 through July 16, 1984
[PB88-123807] N88-18092
SATELLITE INSTRUMENTS
Into the thermosphere: The atmosphere explorers
[NASA-SP-490] N88-18084
SATELLITE OBSERVATION
NROSS (Navy Remote Ocean Sensing System): A force multiplier
[AD-A186853] N88-18045
Earth resources: A continuing bibliography with indexes (supplement 56)
[NASA-SP-7041(56)] N88-18051
Application of satellite data in observational and theoretical studies of the evolving structure of baroclinic waves
[NASA-CR-179277] N88-18091
SATELLITE ROTATION
Preliminary design of the ORION attitude control system
[AD-A187179] N88-17729
SATELLITE TRANSMISSION
MARCE data evaluation N88-17693
SATELLITE-BORNE INSTRUMENTS
Statistical studies of low frequency oscillations in satellite-observed stratospheric temperatures N88-18086
SATURN ATMOSPHERE
An analysis of longitude variations in the equatorial spectrum of Saturn N88-18539
Extended atmospheres of outer planet satellites and comets
[NASA-CR-181449] N88-18540
SATURN SATELLITES
Extended atmospheres of outer planet satellites and comets
[NASA-CR-181449] N88-18540
SCALE (CORROSION)
Beneficial and detrimental effects of silica in the high temperature oxidation of 20Cr/25Ni/Nb stainless steel
[AERE-R-12867] N88-17779
SCALE MODELS
Aerodynamic performance of a scale-model, counter-rotating unducted fan N88-17666
The assessment of the sound insulation requirements for a large broadcasting studio, using a scale model: Practical details
[BBC-RD-1987/21] N88-17678
SCALING LAWS
Plasma physics design and major specifications of candidate reactors for FER design studies. Conceptual design study of FY86 FER
[DE88-751066] N88-18416
SCANNERS
ISTP SBIR phase 1 Full-Sky Scanner: A feasibility study
[NASA-CR-180749] N88-17964
Multidimensional system analysis of electro-optic sensors with sampled deterministic output
[AD-A187083] N88-18399
SCATTERING COEFFICIENTS
Effect of translucence of engineering ceramics on heat transfer in diesel engines
[DE88-003732] N88-17804
SCAVENGING
STS propellant scavenging systems study. Part 2, volume 1: Executive summary and study results
[NASA-CR-179275] N88-17716
STS propellant scavenging systems study. Part 2, volume 2: Cost and WBS/dictionary
[NASA-CR-179276] N88-17717
SCHEDULING
Dynamic processor self-scheduling for general parallel nested loops
[DE88-003572] N88-18311
Deadlock prevention in processor self-scheduling for parallel nested loops
[DE88-003573] N88-18313
SCIENCE
Interdisciplinary research in mathematics, science and technology education
[PB88-131446] N88-18333
SCIENTISTS
Networking requirements and future alternatives
[NASA-TM-89711] N88-18517
SEA ICE
NASA Oceanic Processes Program
[NASA-TM-4025] N88-18109
Physical and structural characteristics of Weddell Sea pack ice
[AD-A188189] N88-18119
SEA SURFACE TEMPERATURE
NASA Oceanic Processes Program
[NASA-TM-4025] N88-18109
SEALING
Metal modification for improved glass-ceramic to metal seals: 1. Auger results on ion implantation and vapor deposition films
[DE88-005244] N88-18006
SEARCHING
Hierachical object recognition using libraries of parameterized model sub-parts
[AD-A187476] N88-18322
SEASONS
Effect of storage thermal behavior in seasonal storage solar heating systems
[PB88-114236] N88-18067
SECONDARY FLOW
Investigation of dihedral effects in compressor cascades N88-17672
Secondary flow measurements with L2F-technique in centrifugal compressors N88-17676
Design and testing of a front stage for an advanced high pressure compressor N88-17679
Computation of secondary flows in an axial multistage compressor N88-17681
Flow patterns induced by vortices
[NAL-TR-932] N88-17963
SECRETIONS
Effect of external electrostatic field on catecholamine secretion by rat adrenals N88-18166
SEDIMENTS
Geological evolution and analysis of confirmed or suspected gas hydrate localities. Volume 10: Basin analysis, formation and stability of gas hydrates of the Aleutian Trench and the Bering Sea
[DE88-001006] N88-18048
Data-base of Antarctic pre-Pleistocene sediment cores
[PB88-124151] N88-18094
Rapid underway sediment classification by electrical methods
[AD-A187447] N88-18113
Rapid underway sediment classification by electrical methods
[AD-A187477] N88-18114
SEEDS
Effect of spaceflight factors on biological material flown aboard Cosmos-1514 biosatellite N88-18154
SEISMOLOGY
A deep-water OBS (Ocean Bottom Seismometer) array with real-time telemetry
[AD-A187404] N88-18112
SELF DIFFUSION (SOLID STATE)
Transport and relaxation processes in supercritical fluids
[DE88-004804] N88-18474
SEMANTICS
Semantics of EqL
[AD-A188151] N88-18297
SEMICIRCULAR CANALS
Membrane model of cupula or vestibular semicircular canals N88-18132
SEMICONDUCTOR DEVICES
Study of quantum mechanical effects in deep submicron, grating-gate field effect transistors
[AD-A188283] N88-17923
Microwave semiconductor research-materials, devices and circuits
[AD-A187121] N88-18444
Corner compensation structures for (110) oriented silicon
[DE88-003300] N88-18455
SEMICONDUCTORS (MATERIALS)
An advanced microcomputer design for processing of semiconductor materials N88-17703
Application of nondestructive testing techniques to materials testing
[AD-A187645] N88-18021
Photochemical solar energy conversion utilizing semiconductors localized in membrane mimetic systems
[DE88-002887] N88-18065
Microwave semiconductor research-materials, devices and circuits
[AD-A187121] N88-18444
Tight binding theory of semiconductors N88-18447
Microscopic control of metallization stability
[AD-A187553] N88-18487
Local stoichiometry and atomic interdiffusion during reactive metal/mercury-cadmium-telluride junction formation
[AD-A187554] N88-18488
Nonmonotonic evolution and thermodynamic trends at metal/(Hg,Cd)Te interfaces: Yb/Hg0.78Cd0.22Te
[AD-A187591] N88-18490
CdTe(110)-Mn interface reaction and the formation of non-equilibrium ternary semimagnetic semiconductor alloys
[AD-A187593] N88-18491
SEMISOLIDS
Electrochromic cells with lutetium diphthalocyanine and semisolid polymer electrolytes
[AD-A188031] N88-18078
SENSITIVITY
Design of a charge sensitive preamplifier on high resistivity silicon
[DE88-003491] N88-17907
SENSORS
ISTP SBIR phase 1 Full-Sky Scanner: A feasibility study
[NASA-CR-180749] N88-17964
Signal and data processing for IR sensors N88-18199
SEPARATED FLOW
Solution of the three-dimensional Navier-Stokes equations for transonic flow using a multigrid method N88-17579
Control of vortical separation on conical bodies N88-17580
SEPARATORS
Research on fluid dynamic energy separation
[DE88-002776] N88-18001
SEQUENCING
Strongly sequential term rewriting systems
[PB88-126693] N88-18334
Linear prediction of stationary vector sequences
[NASA-TM-100069] N88-18366
SEQUENTIAL ANALYSIS
Strongly sequential term rewriting systems
[PB88-126693] N88-18334
SERVICE LIFE
Evaluation of bituminous materials used in pavement recycling projects at Tyndall, MacDill, and Hurlburt Air Force Bases
[AD-A188068] N88-17871
SERVICES
Reuse: A Reliable Unified Service Environment for distributed systems N88-18231
SHAPED CHARGES
Penetration theory for inclined and moving shaped charges
[MBB-UA-940/86] N88-17861
SHEAR FLOW
Investigation of the influence of wind shear on the aerodynamic characteristics of aircraft using a vortex-lattice method N88-17619
SHEAR PROPERTIES
Boundary stabilization of thin elastic plates
[AD-A187123] N88-18025
SHEAR STRAIN
The analysis of deformations and strains in composites by moire interferometry
[AD-A187482] N88-18043
SHEAR STRESS
Strength and structure of Ga sub 1-xIn sub xAs alloys
[AD-A188092] N88-17795
SHEARING
An analytical study of the effects of transverse shear deformation and anisotropy on natural vibration frequencies of laminated cylinders
[NASA-TM-100554] N88-17739
SHIELDING
An estimate of the noise shielding on the fuselage resulting from installing a short duct around an advanced propeller
[NASA-TM-100262] N88-18379
SHOCK WAVE INTERACTION
Experimental research on swept shock wave/boundary layer interactions
[AD-A187250] N88-17957
Velocity measurements in a 3D (three dimensional) shock wave laminar boundary layer interaction
[AD-A187334] N88-17959
The structure and control of three-dimensional shock wave turbulent boundary layer interactions
[AD-A187642] N88-17961
SHOCK WAVES
NF85: A three-dimensional, air-dynamics computer code for analyzing explosions in structures
[DE88-005085] N88-17953
The use of optical fibers for shock pressure and timing measurements at high pressures
[DE88-004012] N88-17971
Supernova mechanisms: Before and after SN1987a
[DE88-003489] N88-18533
SHORELINES
Trace element geochemistry of the South Atlantic Bight
[DE88-003515] N88-18108
SHORT TAKEOFF AIRCRAFT
Recommendations for ground effects research for V/STOL and STOL aircraft and associated equipment for large scale testing
[NASA-CR-177429] N88-17585

An aerodynamic comparison of blown and mechanical high lift airfoils N88-17606
Development of circulation control technology for powered-lift STOL aircraft N88-17608
Circulation control STOL aircraft design aspects N88-17610

SHROUDED PROPELLERS
An estimate of the noise shielding on the fuselage resulting from installing a short duct around an advanced propeller
[NASA-TM-100262] N88-18379

SIGNAL DETECTION
Detection of signals in non-Gaussian correlated noise derived from Cauchy processes
[AD-A187488] N88-17894
A deep-water OBS (Ocean Bottom Seismometer) array with real-time telemetry
[AD-A187404] N88-18112

SIGNAL DETECTORS
A deep-water OBS (Ocean Bottom Seismometer) array with real-time telemetry
[AD-A187404] N88-18112

SIGNAL FADING
The design of trellis codes for fading channels
[NASA-CR-182523] N88-17891

SIGNAL MIXING
Self-pumped phase conjugation in a supersonically flowing medium
[AD-A188281] N88-17996

SIGNAL PROCESSING
Response of wind shear warning systems to turbulence with implication of nuisance alerts N88-17618
Signal processing for an optical wide band data transmission system
[DE88-003854] N88-17886
Detection of signals in non-Gaussian correlated noise derived from Cauchy processes
[AD-A187488] N88-17894
Signal processing studies program optical signal amplification, volume 2
[AD-A188054] N88-17896
Signal processing studies program optical signal amplification, volume 1
[AD-A188055] N88-17897
Signal processing studies program VLSI designs for unary functions
[AD-A188053] N88-17922
An integrated pressure sensor for in-vivo use N88-17965
Optically controlled devices and ultrafast laser sources for signal processing
[AD-A187417] N88-17995
Signal and data processing for IR sensors N88-18199
Wafer scale implementation of a GaAs systolic signal processor cell N88-18247

SIGNAL TO NOISE RATIOS
The relationship between vision carrier-to-noise ratio and picture signal-to-noise ratio in a System I television receiver
[BBC-RD-1987/23] N88-17877

SILENCERS
Silencium resonators (Silators) for the attenuation and elimination of sound
[MBB-Z-546/83] N88-17841

SILICON
The mechanism of anisotropic silicon etching and its relevance for micromachinings
[MBB-UA-1013/86] N88-17838
Laser pulse width dependent surface ripples on silicon
[PB88-127311] N88-17982
Optical measurements of surface oxide layer formation on metal films
[DE88-003163] N88-18405
Corner compensation structures for (110) oriented silicon
[DE88-003300] N88-18455

SILICON ALLOYS
Stability diagrams for epitaxial strained layers
[DE88-003935] N88-18470
Brittle to ductile transition to cleavage fracture
[DE88-004074] N88-18481

SILICON CARBIDES
Fabrication and materials evaluation of high performance aligned ceramic fibre reinforced glass matrix composite
[AERE-R-12517] N88-17736
Micro-mechanisms of deformation in SiC/Al composites
[AD-A188282] N88-17749
Friction and wear of monolithic and fiber reinforced silicon-ceramics sliding against IN-718 alloy at 25 to 800 C in atmospheric air at ambient pressure
[NASA-TM-100294] N88-17796
NMR (Nuclear Magnetic Resonance) imaging for detecting binder/plasticizers in green-state structural ceramics
[DE88-003111] N88-17800
Fabrication, phase transformation studies and characterization of SiC-AlN-Al2OC ceramics
[DE88-004053] N88-17807

SILICON COMPOUNDS
Flash threshold of shocked aluminum silicofluoride
[DE88-003978] N88-18005

SILICON DIOXIDE
Beneficial and detrimental effects of silica in the high temperature oxidation of 20Cr/25Ni/Nb stainless steel
[AERE-R-12667] N88-17779

SILICON FILMS
The soft/hard wet anodization of aluminum oxide and its use in a thin film multilayered capacitor
[AD-A187575] N88-17919
Apparatus for the study of silicon film deposition and silicon etching
[AD-A187616] N88-17972
Grazing incidence X-ray scattering study of defect structures in MBE GaAs/Si using synchrotron radiation
[DE88-004556] N88-18483
Synthesis and characterization of thin films
[AD-A187335] N88-18485

SILICON NITRIDES
NMR (Nuclear Magnetic Resonance) imaging for detecting binder/plasticizers in green-state structural ceramics
[DE88-003111] N88-17800

SILICON RADIATION DETECTORS
Design of a charge sensitive preamplifier on high resistivity silicon
[DE88-003491] N88-17907

SILVER
Adhesion of vapour phase deposited ultra-thin polyimide films on polycrystalline silver
[AD-A187930] N88-17810

SIMD (COMPUTERS)
A parallel computer based on cube connected cycles N88-18227
Introduction to a system for implementing neural net connections on SIMD architectures
[NASA-CR-181612] N88-18279

SIMPLEX METHOD
Eliminating columns in the simplex method for linear programming
[DE88-004191] N88-18277
Continuous deformation algorithm on the product space of unit simplices, revised version
[PB88-114210] N88-18281

SIMULATION
Numerical simulation of axisymmetric turbulent flow in combustors and diffusors
[NASA-CR-4115] N88-17582
NASA wind shear model: Summary of model analyses N88-17617
Satellite interference analysis and simulation using personal computers
[NASA-CR-182522] N88-17890
Evaluation of regional-scale air quality models: Chairmen reports from four workshops
[DE88-001397] N88-18080
Comparative evaluation of stress repsonse of rats to different methods of simulating some effects of weightlessness N88-18144
Morphological study of early changes in rat bones in simulated weightlessness N88-18158
Vector performance of register-to-register vector computers
[DE88-004013] N88-18265
Parallel discrete event simulation: A shared memory approach
[NASA-CR-182521] N88-18312
Performance and optimization of direct implicit time integration schemes for use in electrostatic particle simulation codes
[DE88-003254] N88-18381
Supernova mechanisms: Before and after SN1987a
[DE88-003489] N88-18533
Gamma-ray and neutron spectroscopy of planetary surfaces and atmospheres
[DE88-004287] N88-18541

SINGLE CRYSTALS
CdTe(110)-Mn interface reaction and the formation of non-equilibrium ternary semimagnetic semiconductor alloys
[AD-A187593] N88-18491

SINGLE STAGE ROCKET VEHICLES
Ballistic Single Stage Carrier Vehicle (BETA): A single stage reusable ballistic space shuttle concept
[MBB-UR-949/70] N88-17826

SINTERING
The migration of grain boundaries in ceramic materials with particular reference to the sintering process
[DE88-004085] N88-17808
High temperature processing of superconducting Y1Ba2Cu3O6.9
[DE88-003002] N88-18449
Improved magnetization for YBa2Cu3O/sub 7-delta annealed in oxygen above 1000 C
[DE88-003934] N88-18469
Freestanding films of YBa2Cu3O/sub 6.9/
[DE88-003995] N88-18471

SITE SELECTION
Cape Blanco wind farm feasibility study
[DE88-003748] N88-18059

SITES
An analytic model for ionization distributions produced in nanometer sites by protons
[DE88-003943] N88-18385

SKIN (ANATOMY)
Effect of antiorthostatic position and different illumination on sensitivity of skin in upper half of the body to ultraviolet radiation N88-18145

SKULL
Realistic conductivity geometry model of the human head for interpretation of neuromagnetic data
[PB88-112230] N88-18179

SKY
ISTP SBIR phase 1 Full-Sky Scanner: A feasibility study
[NASA-CR-180749] N88-17964

SLEEP
Discrete adaptation to sensory conflict N88-18146

SLENDER BODIES
Centerplane source distribution for slender bodies N88-17940

SLIDING
Friction and wear of monolithic and fiber reinforced silicon-ceramics sliding against IN-718 alloy at 25 to 800 C in atmospheric air at ambient pressure
[NASA-TM-100294] N88-17796
Stable, robust tracking by sliding mode control
[AD-A188278] N88-18358

SLIDING FRICTION
Mechanisms of wear in single- and two-phase materials
[DE88-003846] N88-17806

SMALL PERTURBATION FLOW
A transonic-small-disturbance wing design methodology
[NASA-TP-2806] N88-17614

SOFTWARE ENGINEERING
An expert system to support the verification/validation of flight-critical software
[MBB-UT-102/87] N88-17852
Design sensitivity analysis of nonlinear structural systems and numerical implementation with established finite element codes N88-18032
Why reusable software isn't N88-18212
Towards reusable software designs and implementations N88-18213
Archetyping: A knowledge-based reuse paradigm N88-18214
Developing a standard taxonomy or software engineering standards N88-18234
Future directions in computer architecture and software workshop N88-18258
A method for assessing the software engineering capability of contractors: Preliminary version
[AD-A187230] N88-18290

SOFTWARE TOOLS
Navigation recovery block design description
[NASA-CR-182473] N88-18022
On parallelism in software/hardware design tools N88-18200
An applicative programmer's approach to matrix algebra, lessons for hardware and software N88-18251
Factors causing unexpected variations in Ada benchmarks
[AD-A187231] N88-18291
Chips: A tool for developing software interfaces interactively
[AD-A187499] N88-18295
The performance of software-managed multiprocessor caches on parallel numerical programs
[DE88-003590] N88-18308

SOLAR ACTIVITY
Neutrino magnetic moment and time variation of solar neutrino flux
[DE88-700687] N88-18542

SOLAR COLLECTORS
Side-by-side comparisons of evacuated compound parabolic concentrator and flat plate solar collector systems at temperatures of 90 to 100°C
[DE88-004717] N88-18073

A solar receiver-reactor with specularly reflecting walls for high-temperature thermoelectrochemical and thermochemical processes
[AD-A187612] N88-18077
Los Alamos optical materials reliability, maintainability, and exposure testing program
[DE88-001953] N88-18404

SOLAR CORONA
Coronal heating by means of helical magnetohydrodynamic turbulence
[AD-A187084] N88-18413

SOLAR DYNAMIC POWER SYSTEMS
Solar concentrator advanced development program, task 1
[NASA-CR-179489] N88-18068

SOLAR ENERGY CONVERSION
Energy transfer and photochemistry in biomimetic solar conversion
[PB88-130026] N88-18057
Photochemical solar energy conversion utilizing semiconductors localized in membrane mimetic systems
[DE88-002887] N88-18065

SOLAR FLARES
Solar-geophysical data number 517, September 1987. Part 1: (Prompt reports). Data for August, July 1987 and late data
[PB88-128426] N88-18544
Solar-geophysical data number 517, September 1987. Part 2: (Comprehensive reports). Data for March 1987 and miscellanea
[PB88-128434] N88-18545

SOLAR FLUX
Neutrino magnetic moment and time variation of solar neutrino flux
[DE88-700687] N88-18542

SOLAR FURNACES
A solar receiver-reactor with specularly reflecting walls for high-temperature thermoelectrochemical and thermochemical processes
[AD-A187612] N88-18077

SOLAR HEATING
Effect of storage thermal behavior in seasonal storage solar heating systems
[PB88-114236] N88-18067

SOLAR MAGNETIC FIELD
Solar-geophysical data number 517, September 1987. Part 1: (Prompt reports). Data for August, July 1987 and late data
[PB88-128426] N88-18544

SOLAR PROMINENCES
Solar-geophysical data number 517, September 1987. Part 2: (Comprehensive reports). Data for March 1987 and miscellanea
[PB88-128434] N88-18545

SOLAR RADIATION
Parameterization of radiative transfer in the Earth's atmosphere with specific applications to clouds N88-18087
Evaluation of surface energy and radiation balance systems on the Konza Prairie
[NASA-CR-182534] N88-18097

SOLAR RADIO BURSTS
Solar-geophysical data number 517, September 1987. Part 2: (Comprehensive reports). Data for March 1987 and miscellanea
[PB88-128434] N88-18545

SOLAR RADIO EMISSION
Solar-geophysical data number 517, September 1987. Part 1: (Prompt reports). Data for August, July 1987 and late data
[PB88-128426] N88-18544

SOLAR WIND
Universal power spectra for wave turbulence: Applications to wind waves, flicker noise, solar wind spectrum and classical second sound N88-17879
Personal overview of solar wind 6
[DE88-003147] N88-18543
The relation of solar wind structure to hydromagnetic discontinuities
[DE88-004304] N88-18546

SOLAR X-RAYS
Solar-geophysical data number 517, September 1987. Part 2: (Comprehensive reports). Data for March 1987 and miscellanea
[PB88-128434] N88-18545

SOLID ELECTROLYTES
Thermogravimetric analysis of polymeric materials for an intermediate temperature solid electrolyte
[DE88-004854] N88-17809
Electrochromic cells with lutetium diphthalocyanine and semisolid polymer electrolytes
[AD-A186031] N88-18078

SOLID MECHANICS
A collaborative program of research in engineering sciences
[DE88-003383] N88-18504

SOLID SOLUTIONS
The physics of metallic superlattices: An experimental point of view
[DE88-003080] N88-18452
Positron-annihilation 2D-ACAR studies of disordered and defected alloys
[DE88-003118] N88-18454

SOLID STATE
Solid-state voltage standard performance and design guidelines
[PB88-123757] N88-17905

SOLID STATE DEVICES
Joint services electronics program
[AD-A187587] N88-17920
Electrochromic cells with lutetium diphthalocyanine and semisolid polymer electrolytes
[AD-A186031] N88-18078

SOLIDIFICATION
Microgravity research at the University of Mexico: Experiments in payload G-006 N88-17892
Application of Onsager's reciprocity relations to interface motion
[DE88-003286] N88-18327

SOLIDS
A modified version of the phase sensitive technique for measurements of absolute sound velocity in solids
[DE88-002303] N88-18378

SOLITARY WAVES
The 80 fsec soliton-like pulses from an optical-nonlinear fiber resonator
[PB88-127303] N88-18403

SOLUTIONS
On the barotropic model of the ocean circulation
[AD-A188148] N88-18118

SOUND TRANSMISSION
Silencium resonators (Silators) for the attenuation and elimination of sound
[MBB-Z-546/83] N88-17841
Sound transmission through the walls of light aircraft: An investigation of structure-borne noise in a Handley Page 137 Jetstream 3 aircraft
[NASA-CR-182509] N88-18376

SOUND WAVES
Cryogenic acoustic microscopy
[AD-A187274] N88-17767
The assessment of the sound insulation requirements for a large broadcasting studio, using a scale model: Practical details
[BBC-RD-1987/21] N88-17878
Johnson noise thermometer for high radiation and high temperature environments
[DE88-003770] N88-17911
Microscopic modeling of sound waves in granular material
[DE88-000348] N88-18375
Scattering of impulsive acoustic waves by a semi-infinite crack in the plane interface of a half-space and a layer
[PB88-126396] N88-18377
A modified version of the phase sensitive technique for measurements of absolute sound velocity in solids
[DE88-002303] N88-18378

SOYUZ SPACECRAFT
Basic results of medical studies during prolonged manned flights on-board the Salyut-7/Soyuz-T orbital complex
[NASA-TT-20217] N88-18182

SPACE ADAPTATION SYNDROME
JPRS Report: Science and Technology. USSR: Space Biology and Aerospace Medicine, volume 21, no. 5, September - October 1987
[JPRS-USB-88-003] N88-18122
Inflight simian circadian rhythms and temperature homeostasis aboard Cosmos-1514 biosatellite N88-18125
Discrete adaptation to sensory conflict N88-18146

SPACE CHARGE
A ring model of the lasertron
[DE88-004656] N88-17908
Generalized equations for emittance and field energy of high-current beams in periodic focusing
[DE88-004448] N88-18372

SPACE COMMERCIALIZATION
The prospects of space utilization
[MBB-UR-931/86] N88-17856
Space-based remote sensing of the Earth: A report to the Congress
[NASA-TM-89709] N88-18046

SPACE DEBRIS
Space station integrated wall damage and penetration damage control. Task 5: Space debris measurement, mapping and characterization system
[NASA-CR-179281] N88-17688

SPACE EXPLORATION
America plans for space
[AD-A187485] N88-17713
Deep space target location with Hubble Space Telescope (HST) and Hipparcos data
[NASA-CR-182520] N88-18524
Interplanetary mission design handbook. Volume 1, Part 5: Mars-to-Earth ballistic mission opportunities, 1992-2007
[NASA-CR-182525] N88-18538

SPACE FLIGHT STRESS
Effect of spaceflight factors on primate's blood circulation N88-18124
Effect of weightlessness on replicative function of rat hepatocyte DNA N88-18129
RNA-synthesizing activity in rat liver following flight aboard Cosmos-1667 N88-18130
Comparative evaluation of stress reponse of rats to different methods of simulating some effects of weightlessness N88-18144
JPRS Report: Science and Technology. USSR: Space Biology and Aerospace Medicine, volume 21, no. 6, November - December 1987
[JPRS-USB-88-004] N88-18150
New book on metabolic aspects of spaceflight stress N88-18172

SPACE INFRARED TELESCOPE FACILITY
Study of helium transfer technology for STICCR: Fluid management
[NASA-CR-177463] N88-17720

SPACE LABORATORIES
System analysis study of space platform and station accommodations for life sciences research facilities. Volume 2: Study results. Appendix E: Work breakdown structure and dictionary
[NASA-CR-179274] N88-17723
System analysis study of space platform and station accommodations for life sciences research facilities. Volume 2: Study results. Appendix D: Life sciences research facility requirements
[NASA-CR-179273] N88-17724

SPACE MISSIONS
America plans for space
[AD-A187485] N88-17713
Rendezvous and docking verification and demonstration in orbit, executive summary
[MBB-303-16/86] N88-17719

SPACE PERCEPTION
Perception and control of simulated self motion
[AD-A187444] N88-18188

SPACE PLATFORMS
System analysis study of space platform and station accommodations for life sciences research facilities. Volume 1: Executive summary. Phase A: Conceptual design and programmatics
[NASA-CR-179268] N88-17721
System analysis study of space platform and station accommodations for life sciences research facilities. Volume 2: Study results, attachment 2. Phase A: Conceptual design and programmatics
[NASA-CR-179272] N88-17722

SPACE PROBES
Rocket and airjet propulsion for ballistic and aerodynamic space probes
[REPT-TR-527] N88-17826

SPACE PROCESSING
Materials processing in space: An introduction to the G-480 payload N88-17695
Ten past and ten future GAS/MAUS-payloads N88-17696
An update to the MITRE/WPI Space Shuttle Program GASCAN G-408 N88-17697
The challenge of G-376 N88-17705
Non-proprietary research projects of the Center for the Space Processing of Engineering Materials
[AR-2] N88-18516

SPACE PROGRAMS
An update to the MITRE/WPI Space Shuttle Program GASCAN G-408 N88-17697

SPACE RENDEZVOUS
Rendezvous and docking verification and demonstration in orbit, executive summary
[MBB-303-16/86] N88-17719

SPACE SHUTTLE BOOSTERS
Shuttle rocket booster computational fluid dynamics
[NASA-CR-182518] N88-17733

SPACE SHUTTLE MISSIONS
The 1987 Get Away Special Experimenter's Symposium
[NASA-CP-2500] N88-17691

SPACE STATION PAYLOADS
System analysis study of space platform and station accommodations for life sciences research facilities. Volume 2: Study results. Appendix E: Work breakdown structure and dictionary
[NASA-CR-179274] N88-17723

System analysis study of space platform and station accommodations for life sciences research facilities. Volume 2: Study results. Appendix D: Life sciences research facility requirements
[NASA-CR-179273] N88-17724

SPACE STATION STRUCTURES
Solar concentrator advanced development program, task 1
[NASA-CR-179489] N88-18068

SPACE STATIONS
Space station integrated wall damage and penetration damage control. Task 5: Space debris measurement, mapping and characterization system
[NASA-CR-179281] N88-17688
The 1987 Get Away Special Experimenter's Symposium
[NASA-CP-2500] N88-17691
Simulation test beds for the space station electrical power system
[NASA-TM-100786] N88-17715
System analysis study of space platform and station accommodations for life sciences research facilities. Volume 1: Executive summary. Phase A: Conceptual design and programmatics
[NASA-CR-179268] N88-17721
System analysis study of space platform and station accommodations for life sciences research facilities. Volume 2: Study results, attachment 2. Phase A: Conceptual design and programmatics
[NASA-CR-179272] N88-17722
Report of the Committee on the Space Station of the National Research Council
[NASA-CR-181602] N88-17727
Magnetic emissions testing of the space station engineering model resistojet
[NASA-TM-100788] N88-17728
Component data base for space station resistojet auxiliary propulsion
[NASA-CR-180834] N88-17731
NASA/NBS (National Aeronautics and Space Administration/National Bureau of Standards) standard reference model for Telerobot Control System Architecture (NASREM)
[PB88-124773] N88-17999

SPACE TRANSPORTATION SYSTEM
STS propellant scavenging systems study. Part 2, volume 1: Executive summary and study results
[NASA-CR-179275] N88-17716
STS propellant scavenging systems study. Part 2, volume 2: Cost and WBS/dictionary
[NASA-CR-179276] N88-17717
Ballistic Single Stage Carrier Vehicle (BETA): A single stage reusable ballistic space shuttle concept
[MBB-UR-949/70] N88-17828
Trends in the development of space transportation systems
[MBB-UR-911/86] N88-17857
Research and technology 1987 annual report of the Kennedy Space Center
[NASA-TM-100303] N88-18548

SPACE-TIME FUNCTIONS
Machine models and simulations
[PB88-118690] N88-18280

SPACEBORNE EXPERIMENTS
Microgravity research at the University of Mexico: Experiments in payload G-006 N88-17692
An update to the MITRE/WPI Space Shuttle Program GASCAN G-408 N88-17697
The photons payload, G-494: A learning experience N88-17701
The challenge of G-376 N88-17705
Project Explorer takes its second step: GAS-608 in engineering development N88-17707
The NORSTAR Program: Space shuttle to space station N88-17710
Into the thermosphere: The atmosphere explorers
[NASA-SP-490] N88-18084

SPACECRAFT CONTROL
Formulation methods of rigid multibody systems for large space structures and some results of computer simulation
[NAL-TR-942] N88-17730

SPACECRAFT DOCKING
Rendezvous and docking verification and demonstration in orbit, executive summary
[MBB-303-16/86] N88-17719

SPACECRAFT ENVIRONMENTS
GAS eleven node thermal model (GEM) N88-17712

SPACECRAFT MODELS
GAS eleven node thermal model (GEM) N88-17712

SPACECRAFT POWER SUPPLIES
Simulation test beds for the space station electrical power system
[NASA-TM-100786] N88-17715
ESL batteries and multi-segment applications — ESA Simulation Language (ESL)
[CS-1029/00-QFIN4] N88-17901

SPACECRAFT PROPULSION
Rocket and airjet propulsion for ballistic and aerodynamic space probes
[REPT-TR-527] N88-17826

SPACECRAFT TRACKING
Investigation of design considerations for Telemetry, Tracking and Command (TT and C) antenna system on Naval Postgraduate School Orion mini-satellite
[AD-A187130] N88-17718

SPACELAB
Project management in astronautics: From Spacelab to Columbus
[MBB-URE-943/87] N88-17858

SPATIAL DISTRIBUTION
Study of quantum mechanical effects in deep submicron, grating-gate field effect transistors
[AD-A188283] N88-17923

SPATIAL MARCHING
Leeside crossflow modeling in Euler space-marching computations
[NASA-TM-89710] N88-17924

SPECIES DIFFUSION
Species biology and potential for controlling four exotic plants (Ammophila arenaria, Carpobrotus edulis, Cortaderia jubata and Gasoul crystallinum) on Vandenberg Air Force Base, California
[NASA-TM-100980] N88-18148

SPECIFIC HEAT
Specific heat of novel thin-film material systems N88-18446

SPECIFIC IMPULSE
Advanced energy conversion concept for beamed-energy propulsion
[AD-A187336] N88-17914

SPECIFICATIONS
Specification of an engine and its components starting from a consideration of aircraft missions N88-17651
Plasma physics design and major specifications of candidate reactors for FER design studies. Conceptual design study of FY86 FER
[DE88-751066] N88-18416
Conceptual design study of Fusion Experimental Reactor (FY86 FER): Safety
[DE88-751071] N88-18418

SPECIMENS
The influence of small defects on tensile specimen ductility and symmetry of deformation
[AD-A187983] N88-18044

SPECTRA
Systematic errors of the FSU global spectral model N88-18103
Well-posedness and spectral estimation for infinite dimensional systems
[AD-A187621] N88-18354

SPECTRAL EMISSION
NBS (National Bureau of Standards) measurement services: Spectral irradiance calibrations
[PB88-123781] N88-18401

SPECTRAL METHODS
Conjugate gradient spectral iterative technique
[PB88-126917] N88-18337
Spectral iterative technique with Gram-Schmidt orthoganalization
[PB88-127451] N88-18338
Domain decomposition preconditioners for the spectral collocation method
[NASA-CR-181620] N88-18345

SPECTRAL RECONNAISSANCE
Earth resources: A continuing bibliography with indexes (supplement 56)
[NASA-SP-7041(56)] N88-18051

SPECTROMETERS
Characterization of the arc/spark excitation sources used in the spectrometric oil analysis program
[AD-A187131] N88-17758
Evaluation of a temperature remote sensing technique
[AD-A187885] N88-18053

SPECTROPHOTOMETRY
High resolution electron and ion microscopy
[AERE-R-12502] N88-17754

SPECTROSCOPY
Product kinetic and internal energy distributions via velocity-aligned Doppler spectroscopy
[DE88-003510] N88-17764
Overview of applications of Laser-Induced Breakdown Spectroscopy (LIBS)
[DE88-004314] N88-17987
Spectroscopic studies of energy transfer in photosynthetic reaction centers of higher plants
[DE88-003850] N88-18121
Rovibrational spectroscopy of ArCO van der Waals complex
[DE88-004291] N88-18387

SPEECH RECOGNITION
Speech recognition: Acoustic-phonetic knowledge acquisition and representation
[AD-A187293] N88-17893
A two-stage isolated-word recognition system using discriminant analysis
[AD-A187425] N88-18360

SPHERES
Light absorption by an atom moving inside a spherical box
[AD-A187241] N88-18395

SPIN
ISTP SBIR phase 1 Full-Sky Scanner: A feasibility study
[NASA-CR-180749] N88-17964

SPIN DYNAMICS
Fundamental properties of spin-polarized quantum systems
[DE88-004425] N88-18499

SPIN TEMPERATURE
Spin disorder resistivity and bare Curie temperature in the ferromagnetic superconductor ErRh4B4
[DE88-003016] N88-18445

SPIN-LATTICE RELAXATION
Transport and relaxation processes in supercritical fluids
[DE88-004804] N88-18474

SPINEL
The migration of grain boundaries in ceramic materials with particular reference to the sintering process
[DE88-004085] N88-17808

SPLITTING
Schwarz splitting and template operators
[AD-A187956] N88-18370

SPRAYED COATINGS
Cost 501 Project UK10 part 3: Thermal fatigue damage of Fecralloy steel-sprayed and co-extruded tubing
[AERE-R-12230] N88-18026

SPREAD SPECTRUM TRANSMISSION
Wideband HF (High Frequency) modeling and simulation
[PB88-116116] N88-17874

SPREADING
Dependence of the expectancy of hitting on the number of spread shots. Determination of the expectancy of hitting using a spread salvo
[REPT-FM6] N88-17829
Investigation of several spread shot conditions
[REPT-TR-164] N88-17830

SPUTTERING
Corrosion behavior of sputter-deposited aluminum-based alloys exposed to chloride solutions
[AD-A187262] N88-17794
Apparatus for the study of silicon film deposition and silicon etching
[AD-A187616] N88-17972
Fabrication and evaluation of transmissive multilayer optics for 8 keV X-rays
[DE88-003999] N88-18402
Synthesis and characterization of thin films
[AD-A187335] N88-18485

STABILITY
Diffusion studies in amorphous NiZr alloys
[DE88-003009] N88-17781
One-dimensional leakage-flow vibration instabilities
[DE88-002875] N88-17947
Instabilities and chaos in a multimode, standing-wave, CW dye laser
[DE88-005028] N88-17993
Comparative evaluation of orthostatic stability following immersion in horizontal and vertical positions N88-18143
Stable, robust tracking by sliding mode control
[AD-A188278] N88-18358
Electronic structure of random alloys and the theory of ordering processes
[DE88-004476] N88-18394

STABILIZATION
Boundary stabilization of thin elastic plates
[AD-A187123] N88-18025
Time delays and boundary feedback stabilization in one-dimensional viscoelasticity, appendices A through H
[AD-A187534] N88-18353

STACKS
Portable (and disposable) interpreters N88-18237

STAINLESS STEELS
Application of ac-impedance method on determination of corrosion rate of metals
[DE88-750307] N88-17771
Effect of low-temperature aging on the mechanical properties of cast stainless steels
[DE88-002872] N88-17774
Studies of the initiation of pitting corrosion on stainless steels
[AERE-M-3615] N88-17778

Beneficial and detrimental effects of silica in the high temperature oxidation of 20Cr/25Ni/Nb stainless steel [AERE-R-12667] N88-17779
Cost 501 Project UK10 part 3: Thermal fatigue damage of Fecralloy steel-sprayed and co-extruded tubing [AERE-R-12230] N88-18026

STALLING
Possibilities for on-line surge suppression by fast guide vane adjustment in axial compressors N88-17674

STANDARDS
Influence of non-metallic elements in the mechanical properties of 20 Mn Mo Ni 55 steel [DE88-700412] N88-17775
Solid-state voltage standard performance and design guidelines [PB88-123757] N88-17905
NBS (National Bureau of Standards) measurement services: Platinum resistance thermometer calibrations [PB88-138367] N88-17967
NASA/NBS (National Aeronautics and Space Administration/National Bureau of Standards) standard reference model for Telerobot Control System Architecture (NASREM) [PB88-124773] N88-17999
Developing a standard taxonomy or software engineering standards N88-18234
NBS (National Bureau of Standards) measurement services: Spectral irradiance calibrations [PB88-123781] N88-18401
Journal of Research of the National Bureau of Standards, volume 92, number 5, September-October 1987 [PB88-124409] N88-18518
Journal of Research of the National Bureau of Standards, volume 92, number 6, November-December 1987 [PB88-138516] N88-18519

STANDING WAVES
Instabilities and chaos in a multimode, standing-wave, CW dye laser [DE88-005028] N88-17993

STATISTICAL ANALYSIS
Helicopter activities in Germany [MBB-UD-487/86] N88-17853
Radar reflectivity and attenuation of radio waves in the melting layer of precipitation [PB88-121553] N88-17882
Statistical studies of low frequency oscillations in satellite-observed stratospheric temperatures N88-18086
On precision and accuracy (bias) statements for measurement procedures [DE88-004434] N88-18359
A generalized quantile estimator under censoring [AD-A186280] N88-18364
Los Alamos optical materials reliability, maintainability, and exposure testing program [DE88-001953] N88-18404
Advances in calculating macroionic solution structure [DE88-003799] N88-18406

STATISTICAL DISTRIBUTIONS
Analysis of gases in the earth's crust [PB88-141619] N88-18093

STATORS
The unsteady gas flow through stator and rotor of a turbomachine N88-17660
Parametric study of choke flutter with a linear theory N88-17673

STEADY STATE
On the barotropic model of the ocean circulation [AD-A188148] N88-18118

STEELS
Influence of non-metallic elements in the mechanical properties of 20 Mn Mo Ni 55 steel [DE88-700412] N88-17775
A detailed microstructural examination of the cause of HAZ cracking in type 316 steel [AERE-R-12428] N88-17777
Effects of commercial cladding on the fracture behavior of pressure vessel steel plates [DE88-004333] N88-17790
Acoustic emission-microstructural relations in ferritic steels. Part 3: The effect of inclusion content [AERE-R-12041] N88-18015
Acoustic emission measurements of PWR weld materials with inserted defects [AERE-R-12386] N88-18016
The measurement of stress in steels of varying microstructure by Barkhausen and magneto-acoustic emission [AERE-R-12387] N88-18027

STELLAR ATMOSPHERES
Onset of type 2 supernova in circumstellar envelope created by the stellar wind from presupernova [DE88-700448] N88-18526
A spherical, non-LTE, blanketed model stellar atmosphere for Phi Cas (FOIa) N88-18528

STELLAR ENVELOPES
Onset of type 2 supernova in circumstellar envelope created by the stellar wind from presupernova [DE88-700448] N88-18526

STELLAR MASS
A spherical, non-LTE, blanketed model stellar atmosphere for Phi Cas (FOIa) N88-18528

STELLAR MASS EJECTION
Stellar energy loss and anomalous contributions to the (photon photon) (neutrino antineutrino) interaction [DE88-700616] N88-18529

STELLAR MODELS
A spherical, non-LTE, blanketed model stellar atmosphere for Phi Cas (FOIa) N88-18528

STELLAR RADIATION
On the time delay of the ultrahigh-energy radiation signal from the source Cygnus X-3 [DE88-700649] N88-18547

STELLAR SPECTRA
Gamma-ray imaging observations of the Crab and Cygnus regions N88-18522
Calculated late time spectra of supernovae [DE88-003296] N88-18530

STELLAR TEMPERATURE
A spherical, non-LTE, blanketed model stellar atmosphere for Phi Cas (FOIa) N88-18528

STELLAR WINDS
Onset of type 2 supernova in circumstellar envelope created by the stellar wind from presupernova [DE88-700448] N88-18526

STELLARATORS
Benchmarks of neutral beam injection codes for stellarators [DE88-003786] N88-18428
Diagnostics for ATF [DE88-004175] N88-18438
ATF experimental plans [DE88-004177] N88-18439

STIFFENING
Optimum design of geodesically stiffened composite plates [NASA-CR-182499] N88-18035

STIMULATION
Role of optokinetic stimulation in vestibulospinal reflexes N88-18131

STIRLING ENGINES
Free-piston Stirling engine diaphragm-coupled heat-actuated heat pump component technology program, phase 1C [DE88-003654] N88-17949

STOCHASTIC PROCESSES
Persistence characteristics of 500 mb blocking and zonal flows in the mid-latitudes of the Northern and Southern Hemispheres N88-18088
Explicit solutions of moment problems, 1 [AD-A186018] N88-18325

STOICHIOMETRY
Local stoichiometry and atomic interdiffusion during reactive metal/mercury-cadmium-telluride junction formation [AD-A187554] N88-18488

STORMS
Using SIR (Scientific Information Retrival) system for data management during a field program [DE88-001555] N88-18508

STRAIN DISTRIBUTION
Computed stress and strain distributions under interference fit and after coldworking [AD-A186950] N88-18024

STRATEGY
Research, development, and growth strategy N88-17820

STRATIGRAPHY
Geological evolution and analysis of confirmed or suspected gas hydrate localities. Volume 10: Basin analysis, formation and stability of gas hydrates of the Aleutian Trench and the Bering Sea [DE88-001006] N88-18048

STRATOSPHERE
Statistical studies of low frequency oscillations in satellite-observed stratospheric temperatures N88-18086
An analysis of longitude variations in the equatorial spectrum of Saturn N88-18539

STREAMS
Ice-shelf response to ice-stream discharge fluctuation. Part 1: Unconfined ice tongues [AD-A188147] N88-18117
A queueing system with independent Markov input streams [AD-A187601] N88-18363

STRESS (PHYSIOLOGY)
Comparative evaluation of stress reponse of rats to different methods of simulating some effects of weightlessness N88-18144
Second All-Union Conference on Physiology of Extreme States and Individual Protection of Man N88-18147

STRESS (PSYCHOLOGY)
Second All-Union Conference on Physiology of Extreme States and Individual Protection of Man N88-18147
Hemodynamic effects of beta-adrenergic blocking with obsidan in clinostatic and orthostatic positions N88-18171

STRESS ANALYSIS
Finite element substructuring methods for composite mechanics [NASA-TM-100297] N88-17745
Analytical and experimental characterization of damage processes in composite laminates [AD-A187221] N88-17746
Basic research on macromolecular dynamics [PB88-141643] N88-17805
Flaw identification from forced vibration testing [DE88-002641] N88-18018
Computed stress and strain distributions under interference fit and after coldworking [AD-A186950] N88-18024
Frequency response function estimation at level [DE88-002644] N88-18034

STRESS CONCENTRATION
Computed stress and strain distributions under interference fit and after coldworking [AD-A186950] N88-18024

STRESS CORROSION
The role of composition and microstructure gradients on weld metal properties and behavior [DE88-004956] N88-17791

STRESS CORROSION CRACKING
Mechanisms of intergranular attack and stress corrosion cracking of alloy 600 by high-temperature caustic solutions containing impurities [DE87-012820] N88-17773

STRESS MEASUREMENT
The measurement of stress in steels of varying microstructure by Barkhausen and magneto-acoustic emission [AERE-R-12387] N88-18027

STRESS-STRAIN RELATIONSHIPS
Relationship between fatigue life in the creep-fatigue region and stress-strain response [NASA-TM-100796] N88-18040

STRESSES
A large strain thermomechanical forming model for elastic-viscoplastic behavior in metals N88-17780
Effects of the neutron spectrum on mechanical property changes in low dose irradiations [DE88-003429] N88-17786
A component synthesis method using Lanczos vectors [DE88-002263] N88-18368

STRING THEORY
Research in theoretical physics: Results from last year 1986/87 [DE88-004922] N88-18502
Cosmic strings: A problem or a solution [DE88-003410] N88-18535

STRIP TRANSMISSION LINES
Time domain wave propagation in multilayered integrated circuits [AD-A187462] N88-17916

STRONTIUM
Superconducting properties and structural characterization of high T/sub c/ oxides [DE88-003479] N88-18477

STRUCTURAL ANALYSIS
Rotorcraft weight trends in light of structural material characteristics [AD-A186576] N88-17642

STRUCTURAL DESIGN
Three-dimensional incompressible flowfield analysis for establishing rotor designs which optimize power extraction N88-17943
Optimal design and parameter identification of flexible rotor-bearing systems N88-18002
Design conditions and workspace for the generally-proportioned 3-hinge spherical wrist for robots N88-18003
Design sensitivity analysis of nonlinear structural systems and numerical implementation with established finite element codes N88-18032
Physical and structural characteristics of Weddell Sea pack ice [AD-A188189] N88-18119

STRUCTURAL MEMBERS
Environment assisted degradation mechanisms in aluminum-lithium alloys [NASA-CR-182482] N88-17782
Modern materials for light constructions --- aircraft [MBB-Z-136/86] N88-17839
Dynamic response of some structural elements fabricated from a non-linear elastic material N88-18031

Optimum design of geodesically stiffened composite plates
[NASA-CR-182499] N88-18035

STRUCTURAL VIBRATION
A review of flow-induced vibration in two-phase flow
[DE88-002873] N88-17946
Strategic placement of accelerometers to measure forces by the sum of weighted accelerations
[DE88-002262] N88-17968
Dynamic response of some structural elements fabricated from a non-linear elastic material N88-18031

STRUCTURES
NF85: A three-dimensional, air-dynamics computer code for analyzing explosions in structures
[DE88-005085] N88-17953

SUBSONIC FLOW
Navier-Stokes computations for circulation control airfoils N88-17592
A numerical study of unsteady two-dimensional subsonic compressible base flow N88-17931

SUBSTRATES
Adhesion of vapour phase deposited ultra-thin polyimide films on polycrystalline silver
[AD-A187930] N88-17810
The soft/hard wet anodization of aluminum oxide and its use in a thin film multilayered capacitor
[AD-A187575] N88-17919
Interactions of cultured human endothelial cells with polymeric surfaces
[PB88-112255] N88-18178
The deposition rate dependence of plasma polymerization on the radius of curvature of the substrate
[DE88-003811] N88-18429
Optical characterization of GaAs/sub 1-x/Sb/sub x/ and GaAs/sub 1-x/Sb/sub x/GaAs strained layer superlattices
[DE88-003393] N88-18464

SUBSTRUCTURES
Finite element substructuring methods for composite mechanics
[NASA-TM-100297] N88-17745

SUDDEN IONOSPHERIC DISTURBANCES
Solar-geophysical data number 517, September 1987. Part 1: (Prompt reports). Data for August, July 1987 and late data
[PB88-128426] N88-18544

SULFONATES
Thermogravimetric analysis of polymeric materials for an intermediate temperature solid electrolyte
[DE88-004854] N88-17809

SULFUR
Acoustic emission-microstructural relations in ferritic steels. Part 3: The effect of inclusion content
[AERE-R-12041] N88-18015

SULFUR DIOXIDES
The role of repowering in America's power generation future
[DOE/FE-0096] N88-18076
The role of analytical chemistry in assessing atmospheric effects of combustion
[DE88-003909] N88-18082

SULFUR FLUORIDES
Kinetic toxic aspect of potential use of sulfur hexafluoride in closed environments N88-18142

SUPERCOMPUTERS
Emerging supercomputer architectures
[DE88-003539] N88-18262
Features of a TeraFlop supercomputer
[DE88-003540] N88-18263
Supercomputer performance: The theory, practice, and results
[DE88-004697] N88-18266
Using program structure to achieve prefetching for cache memories
[DE88-003599] N88-18282
Dynamic processor self-scheduling for general parallel nested loops
[DE88-003572] N88-18311
Performance and evaluation at the Center for Supercomputing Research and Development
[DE88-003563] N88-18456
Center for Supercomputing Research and Development
[DE88-003564] N88-18466

SUPERCONDUCTIVITY
Electrochemical growth of linear conducting crystals in microgravity N88-17698
Spin disorder resistivity and bare Curie temperature in the ferromagnetic superconductor ErRh4B4
[DE88-003016] N88-18445
Normal and superconducting state properties of La2-xSr/sub x/CuO4
[DE88-003013] N88-18450
Superconducting and magnetic properties of Fe-doped oxide superconductors
[DE88-003024] N88-18451
The physics of metallic superlattices: An experimental point of view
[DE88-003080] N88-18452
Electronic structure, charge transfer excitations and high temperature superconductivity
[DE88-003096] N88-18453
Positron-annihilation 2D-ACAR studies of disordered and defected alloys
[DE88-003118] N88-18454
Performance and evaluation at the Center for Supercomputing Research and Development
[DE88-003563] N88-18456
Comparative evaluation of resistive and inductive techniques for measuring temperature of superconducting transition
[DE88-700603] N88-18457
The structure and properties of twin boundaries in superconducting YBa2Cu3O7
[DE88-003864] N88-18468
Freestanding films of YBa2Cu3O/sub 6.9/
[DE88-003995] N88-18471
Grain boundaries, planar defects and superconducting properties of YBa2Cu3O7
[DE88-003477] N88-18475
Superconductivity and phase stability in the heavy rare earth quaternary compounds RBa2Cu3O7 (R = Ho, Er, Tm, Yb, Lu)
[DE88-003478] N88-18476
Superconducting properties and structural characterization of high T/sub c/ oxides
[DE88-003479] N88-18477
Penetration depth measurements of YBa2Cu3O/sub 7-delta/ at 4 MHz
[DE88-003493] N88-18478
The electronic structure of YBa2Cu3O/sub 7-delta/ above and below T/sub c/
[DE88-003495] N88-18479
Simulation and processing of high resolution images of defects and interfaces in superconducting YBa2Cu3O7
[DE88-003856] N88-18480
Innovative arrangements for industry/DOE laboratory collaboration in high temperature superconductivity
[DE88-004320] N88-18482
Superconductivity of thin film intermetallic compounds
[AD-A187563] N88-18489

SUPERCONDUCTORS
Forces on neutral atoms due to electromagnetic fields
[AD-A187461] N88-18396
Spin disorder resistivity and bare Curie temperature in the ferromagnetic superconductor ErRh4B4
[DE88-003016] N88-18445
High temperature processing of superconducting Y1Ba2Cu3O6.9
[DE88-003002] N88-18449
Normal and superconducting state properties of La2-xSr/sub x/CuO4
[DE88-003013] N88-18450
Superconducting and magnetic properties of Fe-doped oxide superconductors
[DE88-003024] N88-18451
Positron-annihilation 2D-ACAR studies of disordered and defected alloys
[DE88-003118] N88-18454
Improved magnetization for YBa2Cu3O/sub 7-delta annealed in oxygen above 1000 C
[DE88-003934] N88-18469
The effect of magnetic impurities and barriers on the magnetization and critical current of fine filament NbTi composites
[DE88-004443] N88-18472
Simulation and processing of high resolution images of defects and interfaces in superconducting YBa2Cu3O7
[DE88-003856] N88-18480
Superconductivity of thin film intermetallic compounds
[AD-A187563] N88-18489

SUPERCRITICAL AIRFOILS
An aerodynamic comparison of blown and mechanical high lift airfoils N88-17606

SUPERCRITICAL FLUIDS
Supercritical fluid extraction-gas chromatography of Volatile Organic Compounds (VOC) from tenax devices
[PB88-124300] N88-17759
Transport and relaxation processes in supercritical fluids
[DE88-004804] N88-18474

SUPERFLUIDITY
Cryogenic acoustic microscopy
[AD-A187274] N88-17767
Superfluid turbulence in He II at elevated pressures N88-18493

SUPERGRAVITY
Research in theoretical physics: Results from last year 1986/87
[DE88-004922] N88-18502

SUPERLATTICES
Optical characterization of GaAs/sub 1-x/Sb/sub x/ and GaAs/sub 1-x/Sb/sub x/GaAs strained layer superlattices
[DE88-003393] N88-18464
Magnetic rare earth superlattices
[DE88-003483] N88-18465
MBE growth, characterization and electronic device processing of HgCdTe, HgZnTe related heterojunctions and HgCdTe-CdTe superlattices
[AD-A187456] N88-18486

SUPERNOVA 1987A
A look at Supernova 1987A
[DE88-003411] N88-18531

SUPERNOVAE
Onset of type 2 supernova in circumstellar envelope created by the stellar wind from presupernova
[DE88-700448] N88-18526
Calculated late time spectra of supernovae
[DE88-003296] N88-18530
Supernova mechanisms: Before and after SN1987a
[DE88-003489] N88-18533

SUPERSONIC AIRFOILS
Supersonic aerodynamics of delta wings
[NASA-TP-2771] N88-17615

SUPERSONIC COMPRESSORS
Application of highly loaded single-stage mixed-flow compressors in small jet-engines N88-17652
Design and testing of a front stage for an advanced high pressure compressor N88-17679

SUPERSONIC FLOW
Application of highly loaded single-stage mixed-flow compressors in small jet-engines N88-17652
Development and application of oxygen flow tagging for velocity measurements and flow visualization in turbulent three-dimensional supersonic flows
[AD-A187982] N88-17714
On the interaction of Tollmein-Schlichting waves in axisymmetric supersonic flows
[NASA-CR-181619] N88-17955
Experimental research on swept shock wave/boundary layer interactions
[AD-A187250] N88-17957
The structure and control of three-dimensional shock wave turbulent boundary layer interactions
[AD-A187642] N88-17961
Self-pumped phase conjugation in a supersonically flowing medium
[AD-A188281] N88-17998

SUPERSONIC NOZZLES
Design of supersonic Coanda jet nozzles N88-17599

SUPERSONIC SPEED
Supersonic aerodynamics of delta wings
[NASA-TP-2771] N88-17615

SUPERSONIC TURBINES
Design and test of a high blade speed, high work capacity transonic turbine N88-17658

SUPERSYMMETRY
On the dynamical supersymmetry of atomic hydrogen
[DE88-700713] N88-18495
Research in theoretical physics: Results from last year 1986/87
[DE88-004922] N88-18502

SURFACE COOLING
Transient cooling of a hot surface by droplets evaporation, March 1986 - March 1987
[PB88-153341] N88-17950

SURFACE ENERGY
Evaluation of surface energy and radiation balance systems on the Konza Prairie
[NASA-CR-182534] N88-18097

SURFACE LAYERS
Tactile sensing and inverse problems
[AD-A187464] N88-18011

SURFACE PROPERTIES
Monitoring interfacial dynamics by pulsed laser techniques
[DE88-003362] N88-17976
Interactions of cultured human endothelial cells with polymeric surfaces
[PB88-112255] N88-18178
Solving complex and disordered surface structures with electron diffraction
[DE88-003863] N88-18467

SURFACE REACTIONS
Beneficial and detrimental effects of silica in the high temperature oxidation of 20Cr/25Ni/Nb stainless steel
[AERE-R-12667] N88-17779
Apparatus for the study of silicon film deposition and silicon etching
[AD-A187616] N88-17972

Nonmonotonic evolution and thermodynamic trends at metal/(Hg,Cd)Te interfaces: Yb/Hg0.78Cd0.22Te
[AD-A187591] N88-18490
SURFACE ROUGHNESS
Interferometric study of natural convection heat transfer from a vertical flat plate with transverse roughness elements N88-17935
SURFACE STABILITY
Microscopic control of metallization stability
[AD-A187553] N88-18487
SURFACE TO SURFACE MISSILES
The effects of data structure on total time on test pilots
[AD-A187628] N88-18296
SURFACE VEHICLES
An overview of vision-based navigation for autonomous land vehicles 1986
[AD-A188186] N88-17640
On the maneuvering of vehicles
[AD-A187632] N88-18521
SURFACE WAVES
Numerical studies of propagation of Lg waves across ocean continent boundaries using the Representation Theorem (RT) N88-18085
SURFACTANTS
Precipitation of surfactants and surfactant mixtures in aqueous solutions
[DE88-003333] N88-17763
SURGES
Possibilities for on-line surge suppression by fast guide vane adjustment in axial compressors N88-17674
SURVEYS
Environmental projects. Volume 4: Asbestos survey
[NASA-CR-182527] N88-18083
SUSPENDING (HANGING)
Comparative evaluation of stress repsonse of rats to different methods of simulating some effects of weightlessness N88-18144
Morphological study of early changes in rat bones in simulated weightlessness N88-18158
SUSPENSION SYSTEMS (VEHICLES)
The MBB propulsion concepts for magnetic suspension railways: Retrospective view and prospects
[MBB-Z-141/87] N88-17865
SWEPT FORWARD WINGS
X-29A forward-swept-wing flight research program status
[NASA-TM-100413] N88-17644
SWEPT WINGS
Pressure distributions and oil-flow patterns for a swept circulation-control wing N88-17596
Boundary-layer and wake measurements on a swept, circulation-control wing N88-17597
SWEPTBACK WINGS
Variable sweep wings N88-17823
SYMBOLIC PROGRAMMING
Optical symbolic processor for expert system execution
[AD-A187494] N88-18268
Deriving abstractions from a software object network
[AD-A187472] N88-18294
Center for Supercomputing Research and Development
[DE88-003564] N88-18466
SYMMETRY
An application of eigenspace methods to symmetric flutter suppression
[NASA-CR-181618] N88-17684
The influence of small defects on tensile specimen ductility and symmetry of deformation
[AD-A187983] N88-18044
SYNCHRONISM
Parallel access to synchronization variables
[DE88-003570] N88-18306
SYNCHROTRON RADIATION
Grazing incidence X-ray scattering study of defect structures in MBE GaAs/Si using synchrotron radiation
[DE88-004556] N88-18483
SYNTAX
Experience with Omega: Implementation of a prototype programming environment, part 6
[AD-A187080] N88-18270
SYNTHESIS (CHEMISTRY)
Thermoplastic elastomers as LOVA binders
[AD-A186563] N88-17797
Electrically conducting polymer-copper sulphide composite films, preparation by treatment of polymer-copper (2) acetate composites with hydrogen sulfide
[NASA-TT-20204] N88-17803
Effect of weightlessness on replicative function of rat hepatocyte DNA N88-18129
RNA-synthesizing activity in rat liver following flight aboard Cosmos-1667 N88-18130
SYNTHETIC APERTURE RADAR
Radar backscatter from airports and surrounding areas N88-17623
Rotor SAR (ROSAR): A new high-resolution all-weather vision method for helicopters
[MBB-UA-1046/87] N88-17855
SAR (Synthetic Aperture Radar) imaging of ship wakes in the Gulf of Alaska
[AD-A186554] N88-17872
SYSTEM FAILURES
Airworthiness considerations N88-17636
SYSTEMS ANALYSIS
Latent failures and coverage in fault-tolerant systems. A VLSI CMOS circuit design technique to aid test generation
[AD-A187615] N88-17921
Comprehensive analysis of helicopters with bearingless rotors
[NASA-CR-182537] N88-18300
A two-stage isolated-word recognition system using discriminant analysis
[AD-A187425] N88-18360
Linear prediction of stationary vector sequences
[NASA-TM-100069] N88-18366
Multidimensional system analysis of electro-optic sensors with sampled deterministic output
[AD-A187083] N88-18399
Development of tokamak reactor system analysis code NEW-TORSAC
[DE88-751067] N88-18417
SYSTEMS ENGINEERING
Knowledge base refinement by monitoring abstract control knowledge, revision 1
[AD-A187502] N88-18323
Multidimensional system analysis of electro-optic sensors with sampled deterministic output
[AD-A187083] N88-18399
Plasma physics design and major specifications of candidate reactors for FER design studies. Conceptual design study of FY86 FER
[DE88-751066] N88-18416
SYSTOLIC ARRAYS
SAGE: The Clemson University Systolic Array Generating Engine N88-18235
Wafer scale implementation of a GaAs systolic signal processor cell N88-18247
On systolic architectures for interpolation and integration N88-18250
Systolic array adaptive beamforming
[AD-A187496] N88-18269

T

TAKEOFF
Radar returns from ground clutter in vicinity of airports N88-17624
Simulator investigation of wind shear recovery techniques N88-17630
TASK COMPLEXITY
Cardiovascular and subjective measures of task demand in a low workload monitoring task
[REPT-8804] N88-18176
TASKS
Trends in the distribution of tasks between commercial pilots and flight control systems
[MBB-UT-008/87] N88-17851
Investigation of effects of short-term exposure to high concentrations of carbon monoxide on operator's psychophysiological functions N88-18133
On the number of task assignments in distributed computing systems N88-18230
Deadlock prevention in processor self-scheduling for parallel nested loops
[DE88-003573] N88-18313
TAXONOMY
Developing a standard taxonomy or software engineering standards N88-18234
TECHNOLOGICAL FORECASTING
Future directions in computer architecture and software workshop N88-18258
Emerging supercomputer architectures
[DE88-003539] N88-18262
TABLET: The personal computer of the year 2000
[NASA-CR-182528] N88-18267
New generation imager system
[NASA-CR-180464] N88-18398
TECHNOLOGIES
JPRS report: Science and Technology. Europe and Latin America
[JPRS-ELS-88-002] N88-17870
TECHNOLOGY ASSESSMENT
An examination of the impact of potential advances in component technology for future military engines N88-17650
Helicopter activities in Germany
[MBB-UD-487/86] N88-17853
Future directions in computer architecture and software: The year 2000 N88-18218
Networking requirements and future alternatives
[NASA-TM-89711] N88-18517
TECHNOLOGY UTILIZATION
Study for history of technology developments in European space projects
[REPT-8518-1] N88-17690
The NORSTAR Program: Space shuttle to space station N88-17710
The prospects of space utilization
[MBB-UR-931/86] N88-17856
Minutes of the meeting of the Indo-US Subcommission on Science and Technology (8th) held at Washington, D.C. on September 22-24, 1986
[PB88-130158] N88-18503
Networking requirements and future alternatives
[NASA-TM-89711] N88-18517
TELEMETRY
Investigation of design considerations for Telemetry, Tracking and Command (TT and C) antenna system on Naval Postgraduate School Orion mini-satellite
[AD-A187130] N88-17718
TELEOPERATORS
NASA/NBS (National Aeronautics and Space Administration/National Bureau of Standards) standard reference model for Telerobot Control System Architecture (NASREM)
[PB88-124773] N88-17999
TELEPHONES
Inexpensive solution for the mass distribution of satellite images
[PB88-114038] N88-17873
TELEVISION TRANSMISSION
The relationship between vision carrier-to-noise ratio and picture signal-to-noise ratio in a System I television receiver
[BBC-RD-1987/23] N88-17877
TEMPERATURE
Strength and structure of Ga sub 1-xIn sub xAs alloys
[AD-A188092] N88-17795
Thermal analysis of transistor packages, part 2
[DE88-005091] N88-17909
TEMPERATURE DEPENDENCE
Flame propagation in the approximation of straight-line trajectories of burning products
[DE88-700675] N88-17756
EXPLO: Explosives thermal analysis computer code
[DE88-001938] N88-17814
Capacitor analysis for RF antennas
[DE88-004178] N88-17883
TEMPERATURE DISTRIBUTION
Approximate solutions of heat conduction in a medium with variable properties
[AD-A186933] N88-17925
TEMPERATURE EFFECTS
The influence of the heating procedure on the oxidation behaviour of NiAl studied by XPS
[AERE-R-12498] N88-17776
A detailed microstructural examination of the cause of HAZ cracking in type 316 steel
[AERE-R-12428] N88-17777
A review of pitting corrosion in high temperature aqueous solutions
[DE88-003547] N88-17787
The measurement of stress in steels of varying microstructure by Barkhausen and magneto-acoustic emission
[AERE-R-12387] N88-18027
TEMPERATURE GRADIENTS
Side-by-side comparisons of evacuated compound parabolic concentrator and flat plate solar collector systems at temperatures of 90 to 100°C
[DE88-004717] N88-18073
TEMPERATURE MEASUREMENT
MARCE data evaluation N88-17693
A reliable data collection/control system N88-17708
CARS measurements of combustion. 1: Precision of thermometry
[NAL-TR-939] N88-17769
NBS (National Bureau of Standards) measurement services: Platinum resistance thermometer calibrations
[PB88-138367] N88-17967
Comparative evaluation of resistive and inductive techniques for measuring temperature of superconducting transition
[DE88-700603] N88-18457
TEMPERATURE MEASURING INSTRUMENTS
Forward looking wind shear detection N88-17629
Evaluation of a temperature remote sensing technique
[AD-A187885] N88-18053
TEMPERATURE PROFILES
GAS eleven node thermal model (GEM) N88-17712

TEMPERATURE SENSORS
Evaluation of a temperature remote sensing technique
[AD-A187885] N88-18053
TEMPERING
The measurement of stress in steels of varying microstructure by Barkhausen and magneto-acoustic emission
[AERE-R-12387] N88-18027
TEMPLATES
Schwarz splitting and template operators
[AD-A187956] N88-18370
TENSILE DEFORMATION
The influence of small defects on tensile specimen ductility and symmetry of deformation
[AD-A187983] N88-18044
TENSILE PROPERTIES
Effects of the neutron spectrum on mechanical property changes in low dose irradiations
[DE88-003429] N88-17786
Durability and damage tolerance of aluminum castings
[AD-A186444] N88-18013
Analysis and application of the constant tensile load test for polyethylene gas pipe materials
[DE88-002868] N88-18037
TENSILE TESTS
High-temperature properties of ceramic fibers and insulations for thermal protection of atmospheric entry and hypersonic cruise vehicles
[NASA-TM-100059] N88-17743
TERMINAL BALLISTICS
Penetration theory for inclined and moving shaped charges
[MBB-UA-940/86] N88-17861
TERNARY ALLOYS
CdTe(110)-Mn interface reaction and the formation of non-equilibrium ternary semimagnetic semiconductor alloys
[AD-A187593] N88-18491
TERRAIN
Radar returns from ground clutter in vicinity of airports N88-17624
TEST EQUIPMENT
Simulation test beds for the space station electrical power system
[NASA-TM-100786] N88-17715
TESTES
Investigation of genetic structures of rat germ cells following flight aboard Cosmos-1514 biosatellite during their prenatal development N88-18155
THEOREMS
Comment on the Adler-Bardeen theorem and related problems
[DE88-751051] N88-18367
THEORETICAL PHYSICS
Research in theoretical physics: Results from last year 1986/87
[DE88-004922] N88-18502
THERMAL ANALYSIS
EXPLO: Explosives thermal analysis computer code
[DE88-001938] N88-17814
Thermal analysis of transistor packages, part 2
[DE88-005091] N88-17909
Microcomputer analysis of regenerative heat exchangers for oscillating flow
[DE88-001773] N88-17945
THERMAL BARRIERS (PLASMA CONTROL)
First and second harmonic ECRH experience at gyrotron frequencies at LLNL
[DE88-003998] N88-18430
THERMAL CONDUCTIVITY
EXPLO: Explosives thermal analysis computer code
[DE88-001938] N88-17814
THERMAL CYCLING TESTS
Cost 501 Project UK10 part 3: Thermal fatigue damage of Fecralloy steel-sprayed and co-extruded tubing
[AERE-R-12230] N88-18026
THERMAL DECOMPOSITION
Low temperature reactivity of chars towards oxygen, appendix E2
[DE88-004088] N88-17760
THERMAL DIFFUSION
Plasma confinement calculations for TIBER-2
[DE88-004044] N88-18425
THERMAL ENERGY
The numerical and analytical study of bifurcation and multicellular flow instability due to natural convection between narrow horizontal isothermal cylindrical annuli at high Rayleigh numbers N88-17937
THERMAL ENVIRONMENTS
MARCE data evaluation N88-17693
THERMAL EXPANSION
Advanced materials for solid oxide fuel cells
[DE88-002338] N88-18071
THERMAL FATIGUE
Dynamic recrystallization during high temperature low cycle fatigue of nickel
[DE88-003224] N88-17788
Cost 501 Project UK10 part 3: Thermal fatigue damage of Fecralloy steel-sprayed and co-extruded tubing
[AERE-R-12230] N88-18026
THERMAL INSULATION
High-temperature properties of ceramic fibers and insulations for thermal protection of atmospheric entry and hypersonic cruise vehicles
[NASA-TM-100059] N88-17743
Thermal analysis of transistor packages, part 2
[DE88-005091] N88-17909
THERMAL SHOCK
Effect of thermal shock on carbon fiber/epoxy composites
[PB88-128228] N88-17741
THERMOCHEMISTRY
A solar receiver-reactor with specularly reflecting walls for high-temperature thermoelectrochemical and thermochemical processes
[AD-A187612] N88-18077
THERMODYNAMIC COUPLING
Specific heat of novel thin-film material systems N88-18446
THERMODYNAMIC PROPERTIES
Calculation and design of a ramjet missile
[REPT-TR-500] N88-17832
Chemical activation of molecules by metals: Experimental studies of electron distributions and bonding
[DE88-004465] N88-18393
Utilization of the JANAF (Joint Army Navy Air Force) database for chemical thermodynamic calculations
[DE88-004571] N88-18501
THERMODYNAMICS
Metal hydrides
[DE88-005083] N88-17766
A large strain thermomechanical forming model for elastic-viscoplastic behavior in metals N88-17780
Collaborative studies of polar cap ionospheric dynamics
[AD-A187888] N88-18098
Nonmonotonic evolution and thermodynamic trends at metal/(Hg,Cd)Te interfaces: Yb/Hg0.78Cd0.22Te
[AD-A187591] N88-18490
Studies in finite time thermodynamics
[DE88-004531] N88-18500
Utilization of the JANAF (Joint Army Navy Air Force) database for chemical thermodynamic calculations
[DE88-004571] N88-18501
Velocity reversal and the arrows of time
[DE88-004237] N88-18536
THERMOGRAPHY
Geological evolution and analysis of confirmed or suspected gas hydrate localities. Volume 10: Basin analysis, formation and stability of gas hydrates of the Aleutian Trench and the Bering Sea
[DE88-001008] N88-18048
THERMOGRAVIMETRY
Thermogravimetric analysis of polymeric materials for an intermediate temperature solid electrolyte
[DE88-004854] N88-17809
THERMOMETERS
Johnson noise thermometer for high radiation and high temperature environments
[DE88-003770] N88-17911
THERMONUCLEAR REACTIONS
Flame propagation in the approximation of straight-line trajectories of burning products
[DE88-700675] N88-17756
Diffusion description of flame propagation due to the translational motion of burning reaction products
[DE88-700676] N88-17757
THERMOPLASTIC RESINS
Thermoplastic elastomers as LOVA binders
[AD-A186563] N88-17797
THERMOSPHERE
The photons payload, G-494: A learning experience N88-17701
Into the thermosphere: The atmosphere explorers
[NASA-SP-490] N88-18084
THICKNESS
Analysis of a turbulent premixed V-flame (influence of flame-thickening)
[NAL-TR-941] N88-17770
THIN FILMS
Diffusion studies in amorphous NiZr alloys
[DE88-003009] N88-17781
The migration of grain boundaries in ceramic materials with particular reference to the sintering process
[DE88-004065] N88-17808
Adhesion of vapour phase deposited ultra-thin polyimide films on polycrystalline silver
[AD-A187930] N88-17810
The soft/hard wet anodization of aluminum oxide and its use in a thin film multilayered capacitor
[AD-A187575] N88-17919
Apparatus for the study of silicon film deposition and silicon etching
[AD-A187616] N88-17972
Monitoring interfacial dynamics by pulsed laser techniques
[DE88-003362] N88-17976
Optical measurements of surface oxide layer formation on metal films
[DE88-003163] N88-18405
Specific heat of novel thin-film material systems N88-18446
The physics of metallic superlattices: An experimental point of view
[DE88-003080] N88-18452
Synthesis and characterization of thin films
[AD-A187335] N88-18485
Superconductivity of thin film intermetallic compounds
[AD-A187563] N88-18489
THIN PLATES
Boundary stabilization of thin elastic plates
[AD-A187123] N88-18025
THREE DIMENSIONAL BOUNDARY LAYER
Velocity measurements in a 3D (three dimensional) shock wave laminar boundary layer interaction
[AD-A187334] N88-17959
The structure and control of three-dimensional shock wave turbulent boundary layer interactions
[AD-A187642] N88-17961
THREE DIMENSIONAL FLOW
Development and application of oxygen flow tagging for velocity measurements and flow visualization in turbulent three-dimensional supersonic flows
[AD-A187982] N88-17714
Three-dimensional Euler solutions for hypersonic Mach numbers
[MBB-UR-944/87] N88-17859
An experimental investigation of pressure driven three-dimensional turbulent boundary layers N88-17934
A three-dimensional dual potential procedure for rotational flows N88-17942
Three-dimensional incompressible flowfield analysis for establishing rotor designs which optimize power extraction N88-17943
Boundary-integral-equation method for computing the three-dimensional flow of groundwater
[PB88-126891] N88-17951
THREE DIMENSIONAL MOTION
Three-dimensional transient electromagnetic modeling for exploration geophysics N88-18047
THRUST AUGMENTATION
Reduction of tilt rotor download using circulation control N88-17605
Circulation control STOL aircraft design aspects N88-17610
A computational study of thrust augmenting ejectors based on a viscous-inviscid approach N88-17929
THRUST DISTRIBUTION
Fixed wing CCW aerodynamics with and without supplementary thrust deflection N88-17607
Development of circulation control technology for powered-lift STOL aircraft N88-17608
THRUST VECTOR CONTROL
Design of supersonic Coanda jet nozzles N88-17599
TILT ROTOR AIRCRAFT
Reduction of tilt rotor download using circulation control N88-17605
Frequency-response identification of XV-15 tilt-rotor aircraft dynamics N88-17643
TILTING ROTORS
Using frequency-domain methods to identify XV-15 aeroelastic modes
[NASA-TM-100033] N88-17646
TIME
Time domain wave propagation in multilayered integrated circuits
[AD-A187462] N88-17916
TIME DEPENDENCE
Physics modeling support contract
[DE88-004039] N88-17980
Scaling physiological pharmacokinetic models by physiological time
[DE88-000335] N88-18173
Performance and optimization of direct implicit time integration schemes for use in electrostatic particle simulation codes
[DE88-003254] N88-18361
Velocity reversal and the arrows of time
[DE88-004237] N88-18536
TIME FUNCTIONS
Calculated late time spectra of supernovae
[DE88-003296] N88-18530

TIME LAG
Time delays and boundary feedback stabilization in one-dimensional viscoelasticity, appendices A through H
[AD-A187534] N88-18353

TIME MEASUREMENT
The use of optical fibers for shock pressure and timing measurements at high pressures
[DE88-004012] N88-17971

TIME SERIES ANALYSIS
Neutrino magnetic moment and time variation of solar neutrino flux
[DE86-700687] N88-18542

TIMOSHENKO BEAMS
Boundary stabilization of thin elastic plates
[AD-A187123] N88-18025

TISSUES (BIOLOGY)
Muscle preservation in the study of bioenergetic effects of hypokinesia N88-18139
Lipid peroxidation in rat tissues with exposure to antiorthostatic hypokinesia, exercise and immobilization stress N88-18159
Interactions of cultured human endothelial cells with polymeric surfaces
[PB88-112255] N88-18178

TITANIUM
Effects of ion implantation on cavitation erosion of a cobalt based metal/carbide alloy
[AD-A187239] N88-17793

TITANIUM ALLOYS
Transmission electron microscopy studies of titanium-containing braze/alumina seals
[DE88-005243] N88-17792

TITANIUM NITRIDES
Bias, internal stress and substrate effects on the microstructure and properties of PVD-wear resistant coatings
[AERE-R-12360] N88-17796

TOKAMAK DEVICES
Tokamak with highly elongated cross-section of a plasma
[DE88-700356] N88-18412
Plasma physics design and major specifications of candidate reactors for FER design studies. Conceptual design study of FY86 FER
[DE88-751066] N88-18416
Development of tokamak reactor system analysis code NEW-TORSAC
[DE88-751067] N88-18417

TOLERANCES (PHYSIOLOGY)
The precision of limits on bodily fluids when using beta-expectation inner tolerance limits
[AD-A187966] N88-18185

TOLLMEIN-SCHLICHTING WAVES
On the interaction of Tollmein-Schlichting waves in axisymmetric supersonic flows
[NASA-CR-181619] N88-17955

TOPOGRAPHY
Estimation of gravity vector components from Bell gravity gradiometer and auxiliary data under consideration of topography and associated analytical upward continuation aspects
[AD-A188146] N88-18099
NASA Oceanic Processes Program
[NASA-TM-4025] N88-18109

TOPOLOGY
The design of impedance- matching networks for broadband antennas
[AD-A187600] N88-17895

TOROIDAL PLASMAS
Evaluation of magnetic coordinates in finite-beta, asymmetric plasmas
[DE88-003665] N88-18424
ATF experimental plans
[DE88-004177] N88-18439

TORQUE
Preliminary design of the ORION attitude control system
[AD-A187179] N88-17729

TORSION
Piezoelectric laminates for torsional and bending model control: Theory and experiment N88-18029

TOUCH
Tactile sensing and inverse problems
[AD-A187464] N88-18011

TOUGHNESS
Finite element substructuring methods for composite mechanics
[NASA-TM-100297] N88-17745
The influence of small defects on tensile specimen ductility and symmetry of deformation
[AD-A187983] N88-18044

TOXICITY
Kinetic toxic aspect of potential use of sulfur hexafluoride in closed environments N88-18142

TRACE ELEMENTS
Trace element geochemistry of the South Atlantic Bight
[DE88-003515] N88-18108

TRACKING (POSITION)
Role of optokinetic stimulation in vestibulospinal reflexes N88-18131
Stable, robust tracking by sliding mode control
[AD-A188278] N88-18358

TRAILING EDGES
Navier-Stokes calculations and turbulence modeling in the trailing edge region of a circulation control airfoil N88-17587
Investigations of a circulation control airfoil flowfield using an advanced laser velocimeter N88-17589

TRAJECTORIES
Simulator investigation of wind shear recovery techniques N88-17630

TRAJECTORY ANALYSIS
Maneuverable reentry vehicle trajectory footprints: Calculation and properties
[DE88-004726] N88-17726
Interplanetary mission design handbook. Volume 1, Part 5: Mars-to-Earth ballistic mission opportunities, 1992-2007
[NASA-CR-182525] N88-18538

TRAJECTORY OPTIMIZATION
Performance and optimization of direct implicit time integration schemes for use in electrostatic particle simulation codes
[DE88-003254] N88-18381

TRANSFER FUNCTIONS
Frequency-response identification of XV-15 tilt-rotor aircraft dynamics N88-17643

TRANSFERRING
Personal computers and All-In-1: Document transfer and translation
[DE88-003760] N88-18264

TRANSFORMATIONS (MATHEMATICS)
Loop coalescing: A compiler transformation for parallel machines
[DE88-003571] N88-18307

TRANSFORMERS
Pulsed current transformer for low inductive loads
[AD-A187224] N88-17913

TRANSISTOR CIRCUITS
Formal multilevel hierarchical verification of synchronous MOS VLSI circuits
[AD-A187532] N88-17918

TRANSISTORS
Thermal analysis of transistor packages, part 2
[DE88-005091] N88-17909

TRANSITION TEMPERATURE
Superconductivity and phase stability in the heavy rare earth quaternary compounds RBa2Cu3O7 (R = Ho, Er, Tm, Yb, Lu)
[DE88-003478] N88-18476

TRANSLATING
Programming language translation for multicomputers N88-18244

TRANSLATIONAL MOTION
Diffusion description of flame propagation due to the translational motion of burning reaction products
[DE88-700676] N88-17757

TRANSLUCENCE
Effect of translucence of engineering ceramics on heat transfer in diesel engines
[DE88-003732] N88-17804

TRANSMISSION EFFICIENCY
Designing variable-length codes with good error-recovery properties
[BBC-RD-1987/19] N88-17876

TRANSONIC COMPRESSORS
Radial compressor design using an Euler solver N88-17675

TRANSONIC FLOW
Solution of the three-dimensional Navier-Stokes equations for transonic flow using a multigrid method N88-17579
Navier-Stokes simulation of wind-tunnel flow using LU-ADI factorization algorithm
[NASA-TM-100042] N88-17584
Navier-Stokes computations for circulation control airfoils N88-17592
Wall jet analysis for circulation control aerodynamics. Part 2: Zonal modeling concepts for wall jet/potential flow coupling N88-17593
A transonic-small-disturbance wing design methodology
[NASA-TP-2806] N88-17614
The unsteady gas flow through stator and rotor of a turbomachine N88-17660

TRANSONIC NOZZLES
A research program on the aerodynamics of a highly loaded turbine stage N88-17655

TRANSPORT AIRCRAFT
Are windshear training aid recommendations appropriate for other than large jet transports? Pilot procedures: Shear models N88-17635
Gear systems for advanced turboprops N88-17667
Research and development. Technical-scientific publications (1956-1987): Retrospective view and prospects. Jubilee edition on the occasion of the 75th birthday of Dipl.-Engr. Dr.-Engr. E. H. Ludwig Boelkow
[ISSN-0931-9751] N88-17819

TRANSPORT PROPERTIES
Transport delay compensation for computer-generated imagery systems
[NASA-TM-100084] N88-17645
Models for ionic transport in glass
[DE88-002860] N88-17799

TRANSPORT THEORY
Applied mathematics of transport theory
[DE88-004098] N88-18369
Studies in finite time thermodynamics
[DE88-004531] N88-18500

TRANSVERSE ACCELERATION
Determination of the drag of missiles with variable lateral acceleration possibility
[REPT-FM15] N88-17831

TRAPPED PARTICLES
Forces on neutral atoms due to electromagnetic fields
[AD-A187481] N88-18396

TREES (MATHEMATICS)
An anlysis of the reliability of tree-structured interconnection networks N88-18228

TRIBOLOGY
Adhesion, friction and micromechanical properties of ceramics
[NASA-TM-100782] N88-17801
Tribology of ceramics: Report of the Committee on Tribology of Ceramics
[NASA-CR-182506] N88-17802

TROPICAL REGIONS
Corrosion and deterioration testing in humid tropic environments
[AD-A186917] N88-17783

TROPOSPHERIC RADIATION
Tropospheric ultraviolet radiation: Assessment of existing data and effect on ozone formation
[PB88-130133] N88-18095

TRUSSES
Solar concentrator advanced development program, task 1
[NASA-CR-179489] N88-18068

TUNGSTEN
Results from the melting of tungsten composites under microgravity (Texus 10 flight)
[PB88-128236] N88-17817
Growth and electronic properties of strained metal overlayers
[DE87-010956] N88-18463

TURBINE BLADES
Advanced Technology for Aero Gas Turbine Components
[AGARD-CP-421] N88-17647
A research program on the aerodynamics of a highly loaded turbine stage N88-17655
Advanced techniques employed in blade cooling research N88-17659
Transonic blade design on rotational stream surfaces N88-17671
Wake interaction effects on the transition process on turbine blades
[AD-A188020] N88-17962

TURBINES
Design and testing of a small radial turbine for auxiliary power units N88-17661
Research on fluid dynamic energy separation
[DE88-002776] N88-18001

TURBOCOMPRESSORS
Advanced Technology for Aero Gas Turbine Components
[AGARD-CP-421] N88-17647
Optimisation of military compressors for weight and volume N88-17649
Operation of gas turbine engines in dust-laden environments N88-17654
Investigation of dihedral effects in compressor cascades N88-17672
Possibilities for on-line surge suppression by fast guide vane adjustment in axial compressors N88-17674
Design and development of an advanced F100 compressor N88-17678
Experimental investigation of a supercritical compressor rotor blade section N88-17680

TURBOJET ENGINES
The coming revolution in turbine engine technology N88-17648
Numerical simulation of diffuser/combustor dome interaction N88-17663

Development of vertical takeoff aircraft with turbojet engines in Germany N88-17822

TURBOMACHINE BLADES
The unsteady gas flow through stator and rotor of a turbomachine N88-17660

TURBOMACHINERY
The unsteady gas flow through stator and rotor of a turbomachine N88-17660
Transonic blade design on rotational stream surfaces N88-17671

TURBOPROP AIRCRAFT
Are windshear training aid recommendations appropriate for other than large jet transports? Pilot procedures: Shear models N88-17635
Sound transmission through the walls of light aircraft: An investigation of structure-borne noise in a Handley Page 137 Jetstream 3 aircraft
[NASA-CR-182509] N88-18376

TURBOPROP ENGINES
Design and aerodynamic performance of a small mixed-flow gas generator turbine N88-17662
Gear systems for advanced turboprops N88-17667

TURBULENCE
Analysis of a turbulent premixed V-flame (influence of flame-thickening)
[NAL-TR-941] N88-17770
Universal power spectra for wave turbulence: Applications to wind waves, flicker noise, solar wind spectrum and classical second sound N88-17879
One-dimensional leakage-flow vibration instabilities
[DE88-002875] N88-17947
Remote sensing of atmospheric crosswinds by utilizing speckle-turbulence interaction and optical heterodyne detection
[AD-A187580] N88-18052
Wake effects in a Fayette 95-IIS wind turbine array
[DE88-001103] N88-18063
Turbulence loads on the Howden 26-m-diameter wind turbine
[TI88-001118] N88-18075
Study of resistive pressure-gradient-driven turbulence
[DE88-005062] N88-18441
Superfluid turbulence in He II at elevated pressures N88-18493

TURBULENT BOUNDARY LAYER
A dynamical system/coherent structure approach to the fully developed turbulent wall layer N88-17578
Burst vortex/boundary layer interaction
[NASA-CR-182510] N88-17583
Boundary layer calculation using digital computers
[REPT-MM-4] N88-17821
An experimental investigation of pressure driven three-dimensional turbulent boundary layers N88-17934
An analysis of the motion and effects of hairpin vortices
[AD-A187261] N88-17958
The structure and control of three-dimensional shock wave turbulent boundary layer interactions
[AD-A187642] N88-17961

TURBULENT FLOW
Solution of the three-dimensional Navier-Stokes equations for transonic flow using a multigrid method N88-17579
Numerical simulation of axisymmetric turbulent flow in combustors and diffusors
[NASA-CR-4115] N88-17582
Navier-Stokes calculations and turbulence modeling in the trailing edge region of a circulation control airfoil N88-17587
Wall jet analysis for circulation control aerodynamics. Part 1: Fundamental CFD and turbulence modeling concepts N88-17588
Investigations of a circulation control airfoil flowfield using an advanced laser velocimeter N88-17589
A theory for turbulent curved wall jets N88-17590
Evaluation of a research circulation control airfoil using Navier-Stokes methods N88-17591
Development and application of oxygen flow tagging for velocity measurements and flow visualization in turbulent three-dimensional supersonic flows
[AD-A187962] N88-17714
Fully Lagrangian Renormalized Approximation theory of fluid turbulence
[DE88-004960] N88-17952
An analysis of the motion and effects of hairpin vortices
[AD-A187261] N88-17958

TURBULENT HEAT TRANSFER
Wake interaction effects on the transition process on turbine blades
[AD-A188020] N88-17962

TURBULENT JETS
A computational study of thrust augmenting ejectors based on a viscous-inviscid approach N88-17929
Turbulence interactions in single- and multi-phase turbulent mixing and combustion processes
[AD-A187505] N88-17960

TURBULENT MIXING
Turbulence interactions in single- and multi-phase turbulent mixing and combustion processes
[AD-A187505] N88-17960

TURBULENT WAKES
SAR (Synthetic Aperture Radar) imaging of ship wakes in the Gulf of Alaska
[AD-A186554] N88-17872
Wake interaction effects on the transition process on turbine blades
[AD-A188020] N88-17962

TURING MACHINES
Machine models and simulations
[PB88-118690] N88-18280

TWINNING
The structure and properties of twin boundaries in superconducting YBa2Cu3O7
[DE88-003864] N88-18468

TWO DIMENSIONAL BOUNDARY LAYER
Boundary layer calculation using digital computers
[REPT-MM-4] N88-17821

TWO DIMENSIONAL FLOW
Parametric study of choke flutter with a linear theory N88-17673
A numerical study of unsteady two-dimensional subsonic compressible base flow N88-17931
Well-posedness and spectral estimation for infinite dimensional systems
[AD-A187621] N88-18354

TWO PHASE FLOW
An experiment to investigate Rankine cycle two-phase microgravity issues
[DE88-004197] N88-17818
Boundary integral analysis of flow and deformation of long bubbles in capillaries
[DE88-002110] N88-17927
Mechanistic model for void distribution in flashing flow
[DE88-002948] N88-17928
Digital imaging techniques for single- and multi-phase reacting flowfields N88-17933
A review of flow-induced vibration in two-phase flow
[DE88-002873] N88-17946

U

U.S.S.R. SPACE PROGRAM
USSR Space Life Sciences Digest, issue 15
[NASA-CR-3922(18)] N88-18175
Basic results of medical studies during prolonged manned flights on-board the Salyut-7/Soyuz-T orbital complex
[NASA-TT-20217] N88-18182

ULTRASONIC FLAW DETECTION
Institute for Materials Science and Engineering, nondestructive evaluation: Technical activities 1987
[PB88-153655] N88-18020

ULTRASONIC TESTS
Ultrasonic characterization of layered composite systems N88-18374

ULTRASONICS
Durability and damage tolerance of aluminum castings
[AD-A186444] N88-18013

ULTRAVIOLET LASERS
Research studies on extreme ultraviolet and soft X-ray lasers
[AD-A187506] N88-17996

ULTRAVIOLET RADIATION
Tropospheric ultraviolet radiation: Assessment of existing data and effect on ozone formation
[PB88-130133] N88-18095

ULTRAVIOLET SPECTROSCOPY
Two-photon (VUV and visible) resonant ionization spectroscopy of atoms and molecules
[DE88-004332] N88-18388

UNDER SURFACE BLOWING
Wind tunnel studies of circulation control elliptical airfoils N88-17598
Analysis of a fixed-pitch X-wing rotor employing lower surface blowing N88-17602

UNITED STATES
America plans for space
[AD-A187465] N88-17713

UNIVERSE
The origin of the diffuse X-ray background and the formation of galaxies and voids N88-18527
On the time delay of the ultrahigh-energy radiation signal from the source Cygnus X-3
[DE88-700649] N88-18547

UNIVERSITIES
TABLET: The personal computer of the year 2000
[NASA-CR-182528] N88-18267

UNSTEADY AERODYNAMICS
Investigation of dynamic stall using LDV (Laser Doppler Velocimetry): Mean flow studies
[AD-A187629] N88-17611
Effectiveness of various control surfaces in quasi-steady and unsteady conditions
[AGARD-R-735] N88-17682

UNSTEADY FLOW
The unsteady gas flow through stator and rotor of a turbomachine N88-17660
Parametric study of choke flutter with a linear theory N88-17673
Ice-shelf response to ice-stream discharge fluctuation. Part 1: Unconfined ice tongues
[AD-A188147] N88-18117
Well-posedness and spectral estimation for infinite dimensional systems
[AD-A187621] N88-18354

UPPER SURFACE BLOWING
On the effect of leading edge blowing on circulation control airfoil aerodynamics N88-17595
A potential flight evaluation of an upper-surface-blowing/circulation-control-wing concept N88-17609

USER MANUALS (COMPUTER PROGRAMS)
Operators manual for a computer controlled impedance measurement system
[AD-A187513] N88-17917

USER REQUIREMENTS
Shared workspaces for real-time collaboration in distributed networks: Concepts, techniques, problems
[AD-A188150] N88-18315

V

V/STOL AIRCRAFT
Application of empirical and linear methods to VSTOL powered-lift aerodynamics
[NASA-TM-100048] N88-17581
Recommendations for ground effects research for V/STOL and STOL aircraft and associated equipment for large scale testing
[NASA-CR-177429] N88-17585
A computational study of thrust augmenting ejectors based on a viscous-inviscid approach N88-17929

VACUUM DEPOSITION
Synthesis and characterization of thin films
[AD-A187335] N88-18485

VANES
Experimental evaluation of a translating nozzle sidewall radial turbine N88-17656

VAPOR DEPOSITION
Microgravity research at the University of Mexico: Experiments in payload G-006 N88-17692
Metal modification for improved glass-ceramic to metal seals: 1. Auger results on ion implantation and vapor deposition films
[DE88-005244] N88-18006
Fabrication and evaluation of transmissive multilayer optics for 8 keV X-rays
[DE88-003999] N88-18402

VAPOR PHASES
Gas phase pulse radiolysis
[DE88-002981] N88-17751
Adhesion of vapour phase deposited ultra-thin polyimide films on polycrystalline silver
[AD-A187930] N88-17810
Investigation of real-time two-dimensional visualization of fuel spray liquid/vapor distribution via exciplex fluorescence
[AD-A188268] N88-17816

VARIABILITY
Designing variable-length codes with good error-recovery properties
[BBC-RD-1987/19] N88-17876
Implementing logical variables on a graph reduction architecture N88-18252
Parallel access to synchronization variables
[DE88-003570] N88-18306

VARIABLE PITCH PROPELLERS
Analysis of possible transmission arrangements applicable for driving single or twin counterrotating fans on propfan engines N88-17670

VARIABLE SWEEP WINGS
Variable sweep wings N88-17823

VARIATIONAL PRINCIPLES
Hypersonic blunt body computations including real gas effects
[NASA-TM-100074] N88-18344

VARIATIONS
The advantage of variable geometry for turbine engines at low power N88-17653
Ice-shelf response to ice-stream discharge fluctuation. Part 1: Unconfined ice tongues
[AD-A188147] N88-18117

VECTOR ANALYSIS
Estimation of gravity vector components from Bell gravity gradiometer and auxiliary data under consideration of topography and associated analytical upward continuation aspects
[AD-A188146] N88-18099
An efficient sparse matrix multiplication scheme for the CYBER 205 computer
[NASA-TM-4026] N88-18302
Vector bundles over real algebraic varieties
[PB88-126677] N88-18335

VECTOR SPACES
An application of eigenspace methods to symmetric flutter suppression
[NASA-CR-181618] N88-17684

VECTORS (MATHEMATICS)
Vector performance of register-to-register vector computers
[DE88-004013] N88-18265
Implementation and analysis of a Navier-Stokes algorithm on parallel computers
[NASA-CR-181614] N88-18301
Straightening and the Stanley decomposition for the (2;n)-nilpotent vectorfield
[PB88-126685] N88-18336
Linear prediction of stationary vector sequences
[NASA-TM-100069] N88-18366

VEGETATION
Physiological and ecological implications of coupled heat- and water-transport mechanisms of endotherms and vegetation
[DE88-004170] N88-18061

VEGETATION GROWTH
Species biology and potential for controlling four exotic plants (Ammophila arenaria, Carpobrotus edulis, Cortaderia jubata and Gasoul crystallinum) on Vandenberg Air Force Base, California
[NASA-TM-100980] N88-18148

VELOCITY
Velocity measurements in a 3D (three dimensional) shock wave laminar boundary layer interaction
[AD-A187334] N88-17959
Velocity reversal and the arrows of time
[DE88-004237] N88-18536

VELOCITY DISTRIBUTION
Investigations of a circulation control airfoil flowfield using an advanced laser velocimeter N88-17589
Boundary-layer and wake measurements on a swept, circulation-control wing N88-17597
Transonic blade design on rotational stream surfaces N88-17671
Implicit solution of the incompressible Navier-Stokes equations in primitive variables on non-staggered grids N88-17930

VELOCITY MEASUREMENT
Development and application of oxygen flow tagging for velocity measurements and flow visualization in turbulent three-dimensional supersonic flows
[AD-A187982] N88-17714

VERTICAL AIR CURRENTS
NASA wind shear model: Summary of model analyses N88-17617
Windshear detection effect of static air temperature bias N88-17621
Are windshear training aid recommendations appropriate for other than large jet transports? Pilot procedures: Shear models N88-17635

VERTICAL TAKEOFF AIRCRAFT
Development of a plenum chamber burner system for an advanced VTOL engine N88-17664
Development of vertical takeoff aircraft with turbojet engines in Germany N88-17822

VERY LARGE SCALE INTEGRATION
Formal multilevel hierarchical verification of synchronous MOS VLSI circuits
[AD-A187532] N88-17918
Latent failures and coverage in fault-tolerant systems. A VLSI CMOS circuit design technique to aid test generation
[AD-A187615] N88-17921
Signal processing studies program VLSI designs for unary functions
[AD-A188053] N88-17922
The arithmetic cube and its associated algorithms N88-18195
Wafer scale implementation of a GaAs systolic signal processor cell N88-18247
A VLSI implementable block oriented data driven multiprocessor N88-18249
On systolic architectures for interpolation and integration N88-18250

VERY LONG BASE INTERFEROMETRY
Observation model and parameter partials for the JPL VLBI parameter estimation software MASTERFIT-1987
[NASA-CR-182524] N88-18523

VESTIBULAR NYSTAGMUS
Role of optokinetic stimulation in vesibulospinal reflexes N88-18131

VIBRATION
An analytical study of the effects of transverse shear deformation and anisotropy on natural vibration frequencies of laminated cylinders
[NASA-TM-100554] N88-17739
One-dimensional leakage-flow vibration instabilities
[DE88-002875] N88-17947
Vibration and flutter characteristics of the SR7L large-scale propfan
[NASA-TM-100272] N88-18036
Modal testing the EOLE
[DE88-003795] N88-18066
Modal testing of a very flexible 110 m wind turbine structure
[DE88-003796] N88-18072
The Shock and Vibration Digest, volume 20, no. 2 N88-18459

VIBRATION DAMPING
Using frequency-domain methods to identify XV-15 aeroelastic modes
[NASA-TM-100033] N88-17646
Sensitivity of active vibration control to structural changes and model reduction N88-17683

VIBRATION MEASUREMENT
A reliable data collection/control system N88-17708
Flaw identification from forced vibration testing
[DE88-002641] N88-18018

VIBRATION SIMULATORS
Ultra-low frequency vibration data acquisition concerns in operating flight simulators
[DE88-004795] N88-17687

VIBRATIONAL SPECTRA
Kinetic studies following state-selective laser excitation
[DE88-004094] N88-17981
Rovibrational spectroscopy of ArCO van der Waals complex
[DE88-004291] N88-18387

VIRTUAL MEMORY SYSTEMS
Parallel garbage collection on a virtual memory system
[DE88-003567] N88-18317

VISCOELASTICITY
A finite element analysis of adhesively bonded composite joints including geometric nonlinearity, nonlinear viscoelasticity moisture diffusion and delayed failure
[AD-A187455] N88-17747
Time delays and boundary feedback stabilization in one-dimensional viscoelasticity, appendices A through H
[AD-A187534] N88-18353

VISCOPLASTICITY
A large strain thermomechanical forming model for elastic-viscoplastic behavior in metals N88-17780

VISCOSITY
Viscosity methods in optimal control of distributed systems
[AD-A188086] N88-18357

VISCOUS FLOW
Zonal solutions for viscous flow problems. Finite approximations in fluid mechanics
[MBB/LKE-122/S/PUB/226] N88-17846
A three-dimensional dual potential procedure for rotational flows N88-17942

VISION
The relationship between vision carrier-to-noise ratio and picture signal-to-noise ratio in a System I television receiver
[BBC-RD-1987/23] N88-17877
Hierachical object recognition using libraries of parameterized model sub-parts
[AD-A187476] N88-18322

VISUAL ACUITY
The accommodative status in the dark of US Navy fighter pilots
[AD-A188188] N88-18186

VISUAL PERCEPTION
Perception and control of simulated self motion
[AD-A187444] N88-18188

VISUAL SIGNALS
Helicopter external vision requirements and visual display characteristics: A report/bibliography, revision A
[AD-A187075] N88-17641

VISUAL STIMULI
Role of optokinetic stimulation in vesibulospinal reflexes N88-18131

VOICE OF AMERICA
Complementary satellite sound broadcasting systems: A NASA assessment for the Voice of America
[NASA-TM-100300] N88-17899

VOLT-AMPERE CHARACTERISTICS
Solid-state voltage standard performance and design guidelines
[PB88-123757] N88-17905

VOLUME
Evaluation of spare room in cerebrospinal system using noninvasive methods N88-18137

VORTEX BREAKDOWN
Control of vortical separation on conical bodies N88-17580
Burst vortex/boundary layer interaction
[NASA-CR-182510] N88-17583

VORTEX GENERATORS
Burst vortex/boundary layer interaction
[NASA-CR-182510] N88-17583

VORTEX SHEDDING
A numerical study of unsteady two-dimensional subsonic compressible base flow N88-17931

VORTEX SHEETS
Coronal heating by means of helical magnetohydrodynamic turbulence
[AD-A187084] N88-18413

VORTICES
Investigation of the influence of wind shear on the aerodynamic characteristics of aircraft using a vortex-lattice method N88-17619
Secondary flow measurements with L2F-technique in centrifugal compressors N88-17676
Investigation of non-symmetric jets in cross flow N88-17932
Instability and transition in curved channel flow N88-17938
An analysis of the motion and effects of hairpin vortices
[AD-A187261] N88-17958
Flow patterns induced by vortices
[NAL-TR-932] N88-17963

VORTICITY
Free-surface flow phenomena ahead of a two-dimensional body in a viscous fluid N88-17944

W

WAFERS
Wafer scale implementation of a GaAs systolic signal processor cell N88-18247
Corner compensation structures for (110) oriented silicon
[DE88-003300] N88-18455

WAKES
Boundary-layer and wake measurements on a swept, circulation-control wing N88-17597
SAR (Synthetic Aperture Radar) imaging of ship wakes in the Gulf of Alaska
[AD-A186554] N88-17872
Emittance studies at the Los Alamos National Laboratory Free-Electron Laser (FEL)
[DE88-003146] N88-17975
Wake effects in a Fayette 95-IIS wind turbine array
[DE88-001103] N88-18063

WALKING
Morphological manifestations of primate adaptation to orthograde statics and walking erect N88-18162

WALL FLOW
A dynamical system/coherent structure approach to the fully developed turbulent wall layer N88-17578
Navier-Stokes simulation of wind-tunnel flow using LU-ADI factorization algorithm
[NASA-TM-100042] N88-17584

WALL JETS
Wall jet analysis for circulation control aerodynamics. Part 1: Fundamental CFD and turbulence modeling concepts N88-17588
A theory for turbulent curved wall jets N88-17590
Wall jet analysis for circulation control aerodynamics. Part 2: Zonal modeling concepts for wall jet/potential flow coupling N88-17593

WALLS
Space station integrated wall damage and penetration damage control. Task 5: Space debris measurement, mapping and characterization system
[NASA-CR-179281] N88-17688
One-dimensional leakage-flow vibration instabilities
[DE88-002875] N88-17947
An analysis of the motion and effects of hairpin vortices
[AD-A187261] N88-17958

WARNING SYSTEMS
Airborne Wind Shear Detection and Warning Systems: First Combined Manufacturers' and Technologists' Conference
[NASA-CP-10006] N88-17616
Response of wind shear warning systems to turbulence with implication of nuisance alerts N88-17618

Windshear warning aerospatiale approach N88-17620
Lidar windshear detection and avoidance: Performance and technical assessment N88-17626
Infrared low-level wind shear work N88-17628
Crew interface with windshear systems N88-17631
Status of FAA terminal Doppler weather radar programs N88-17632
The advanced low-level windshear alert system operational demonstration results, Summer, 1987, Denver Stapleton International Airport N88-17633
Information transfer in the National Airspace System N88-17634
Airworthiness considerations N88-17636

WASHING
Analysis of water recovered after being used for washing by men and women N88-18135

WATER
Analysis of water recovered after being used for washing by men and women N88-18135

WATER FLOW
Boundary-integral-equation method for computing the three-dimensional flow of groundwater [PB88-126891] N88-17951

WATER IMMERSION
Comparative evaluation of orthostatic stability following immersion in horizontal and vertical positions N88-18143

WATER POLLUTION
Trace element geochemistry of the South Atlantic Bight [DE88-003515] N88-18106

WATER WAVES
SAR (Synthetic Aperture Radar) imaging of ship wakes in the Gulf of Alaska [AD-A186554] N88-17872
Analysis of wind turbines on offshore support structures excited by random wind and random waves [DE88-004772] N88-18074

WAVE AMPLIFICATION
Simulation and modeling of whistler mode wave growth through cyclotron resonance with energetic electrons in the magnetosphere N88-18089

WAVE ATTENUATION
Radar reflectivity and attenuation of radio waves in the melting layer of precipitation [PB88-121553] N88-17882
Numerical studies of propagation of Lg waves across ocean continent boundaries using the Representation Theorem (RT) N88-18085

WAVE DISPERSION
Betatron oscillations in a free electron laser [DE88-004859] N88-17990

WAVE FRONT DEFORMATION
Calculation of the spatial-temporal deformation of laser pulses in multiple scattering [MBB-Z-111/87] N88-17837

WAVE FUNCTIONS
An overview of the transactional interpretation of quantum mechanics [DE88-004236] N88-18497

WAVE INTERACTION
Universal power spectra for wave turbulence: Applications to wind waves, flicker noise, solar wind spectrum and classical second sound N88-17879
On the interaction of Tollmein-Schlichting waves in axisymmetric supersonic flows [NASA-CR-181619] N88-17955
Velocity measurements in a 3D (three dimensional) shock wave laminar boundary layer interaction [AD-A187334] N88-17959

WAVE PROPAGATION
Flame propagation in the approximation of straight-line trajectories of burning products [DE88-700675] N88-17756
Diffusion description of flame propagation due to the translational motion of burning reaction products [DE88-700676] N88-17757
Time domain wave propagation in multilayered integrated circuits [AD-A187462] N88-17916
Numerical studies of propagation of Lg waves across ocean continent boundaries using the Representation Theorem (RT) N88-18085
Simulation and modeling of whistler mode wave growth through cyclotron resonance with energetic electrons in the magnetosphere N88-18089

WAVEGUIDES
Modeling of some coplanar waveguide discontinuities [NASA-TM-100808] N88-17880
Guided-wave approaches to spectrally selective energy absorption [NASA-CR-182532] N88-17892
First and second harmonic ECRH experience at gyrotron frequencies at LLNL [DE88-003998] N88-18430

WAVELENGTHS
Modern pulsed wavemeters [DE88-003875] N88-17978

WEAPON SYSTEMS
Research and development. Technical-scientific publications (1956-1987): Retrospective view and prospects. Jubilee edition on the occasion of the 75th birthday of Dipl.-Engr. Dr.-Engr. E. H. Ludwig Boelkow [ISSN-0931-9751] N88-17819
Investigation of several spread shot conditions [REPT-TR-164] N88-17830

WEAPONS DELIVERY
Investigation of several spread shot conditions [REPT-TR-164] N88-17830

WEAR
Characterization of the arc/spark excitation sources used in the spectrometric oil analysis program [AD-A187131] N88-17758
Friction and wear of monolithic and fiber reinforced silicon-ceramics sliding against IN-718 alloy at 25 to 800 C in atmospheric air at ambient pressure [NASA-TM-100294] N88-17796
Tribology of ceramics: Report of the Committee on Tribology of Ceramics [NASA-CR-182506] N88-17802
Mechanisms of wear in single- and two-phase materials [DE88-003848] N88-17806

WEAR RESISTANCE
Bias, internal stress and substrate effects on the microstructure and properties of PVD-wear resistant coatings [AERE-R-12360] N88-17798

WEATHER
The structure and dynamics of monsoon depressions N88-18102

WEATHER FORECASTING
Status of FAA terminal Doppler weather radar programs N88-17632
AEV local verification for aviation, precipitation and temperature programs: AV, REL, TEM (September 1987 revision) [PB88-115662] N88-18101
Systematic errors of the FSU global spectral model N88-18103

WEATHERING
Application of inverse gas chromatography to fluidity studies [DE88-002896] N88-17750

WEIGHT REDUCTION
Rotorcraft weight trends in light of structural material characteristics [AD-A186576] N88-17642
Lightsats and their attraction to budget oriented Federal agencies N88-17711
Modern materials for light constructions — aircraft [MBB-Z-136/86] N88-17839

WEIGHTING FUNCTIONS
Five-diagonal weighting scheme for geoidal profiles [AD-A188033] N88-18054
On the dynamic estimation of relative weights for observation and forecast in numerical weather prediction [NASA-CR-182531] N88-18106

WEIGHTLESSNESS
JPRS Report: Science and Technology. USSR: Space Biology and Aerospace Medicine, volume 21, no. 5, September - October 1987 [JPRS-USB-88-003] N88-18122
Embryonic development of guppy in weightlessness N88-18127
Histomorphometric analysis of rat bones after spaceflight aboard Cosmos-1667 biosatellite N88-18128
Isotope methods of determining distribution and movement of blood in the body N88-18138
Comparative evaluation of stress repsonse of rats to different methods of simulating some effects of weightlessness N88-18144
Morphological study of early changes in rat bones in simulated weightlessness N88-18158
New book on metabolic aspects of spaceflight stress N88-18172

WELDED JOINTS
The role of composition and microstructure gradients on weld metal properties and behavior [DE88-004956] N88-17791
The influence of small defects on tensile specimen ductility and symmetry of deformation [AD-A187983] N88-18044

WELDED STRUCTURES
Acoustic emission measurements of PWR weld materials with inserted defects [AERE-R-12386] N88-18016

WELDING
A large strain thermomechanical forming model for elastic-viscoplastic behavior in metals N88-17780
The role of composition and microstructure gradients on weld metal properties and behavior [DE88-004956] N88-17791
A collaborative program of research in engineering sciences [DE88-003383] N88-18504

WEST GERMANY
AZUR, the first German research satellite 625-A, 1964-1969 N88-17827

WETTING
Effects of aviation fluids on carbon fibre composite material [PB88-127857] N88-17740

WHISKER COMPOSITES
Micro-mechanisms of deformation in SiC/Al composites [AD-A188282] N88-17749

WHISTLERS
Simulation and modeling of whistler mode wave growth through cyclotron resonance with energetic electrons in the magnetosphere N88-18089

WIGGLER MAGNETS
Tapered wiggler analysis of high gain free electron laser oscillators [AD-A187997] N88-17997

WIND (METEOROLOGY)
Airborne Doppler radar technology for wind shear detection N88-17622
Radar backscatter from airports and surrounding areas N88-17623
Universal power spectra for wave turbulence: Applications to wind waves, flicker noise, solar wind spectrum and classical second sound N88-17879
Remote sensing of atmospheric crosswinds by utilizing speckle-turbulence interaction and optical heterodyne detection [AD-A187580] N88-18052
The structure and dynamics of monsoon depressions N88-18102
Systematic errors of the FSU global spectral model N88-18103

WIND DIRECTION
Remote sensing of atmospheric crosswinds by utilizing speckle-turbulence interaction and optical heterodyne detection [AD-A187580] N88-18052

WIND MEASUREMENT
Minimum Energy Routing through Interactive Techniques (MERIT) modeling [NASA-CR-182535] N88-18105

WIND SHEAR
Airborne Wind Shear Detection and Warning Systems: First Combined Manufacturers' and Technologists' Conference [NASA-CP-10006] N88-17616
NASA wind shear model: Summary of model analyses N88-17617
Response of wind shear warning systems to turbulence with implication of nuisance alerts N88-17618
Investigation of the influence of wind shear on the aerodynamic characteristics of aircraft using a vortex-lattice method N88-17619
Windshear warning aerospatiale approach N88-17620
Windshear detection effect of static air temperature bias N88-17621
Airborne Doppler radar technology for wind shear detection N88-17622
Radar backscatter from airports and surrounding areas N88-17623
Wind shear radar simulation N88-17625
Lidar windshear detection and avoidance: Performance and technical assessment N88-17626
Airborne Doppler lidar detection of wind shear. Results of performance analysis N88-17627
Infrared low-level wind shear work N88-17628
Forward looking wind shear detection N88-17629
Simulator investigation of wind shear recovery techniques N88-17630
Crew interface with windshear systems N88-17631
Status of FAA terminal Doppler weather radar programs N88-17632
The advanced low-level windshear alert system operational demonstration results, Summer, 1987, Denver Stapleton International Airport N88-17633
Are windshear training aid recommendations appropriate for other than large jet transports? Pilot procedures: Shear models N88-17635
Airworthiness considerations N88-17636
Windshear training aid. Volume 1: Overview, pilot guide, training program [PB88-127196] N88-17637

WIND TUNNEL APPARATUS
Experimental evaluation of turning vane designs for high-speed and coupled fan-drive corners of 0.1-scale model of NASA Lewis Research Center's proposed altitude wind tunnel
[NASA-TP-2681] N88-17686
WIND TUNNEL DRIVES
Experimental evaluation of turning vane designs for high-speed and coupled fan-drive corners of 0.1-scale model of NASA Lewis Research Center's proposed altitude wind tunnel
[NASA-TP-2681] N88-17686
WIND TUNNEL TESTS
Investigations of a circulation control airfoil flowfield using an advanced laser velocimeter N88-17589
Prediction of aeroelastic response of a model X-wing rotor N88-17603
Analysis of highspeed propellers aerodynamics N88-17669
Experimental investigation of a supercritical compressor rotor blade section N88-17680
Effectiveness of various control surfaces in quasi-steady and unsteady conditions
[AGARD-R-735] N88-17682
An experimental investigation of pressure driven three-dimensional turbulent boundary layers N88-17934
A three-dimensional dual potential procedure for rotational flows N88-17942
WIND TURBINES
Cape Blanco wind farm feasibility study
[DE88-003749] N88-18060
Wake effects in a Fayette 95-IIS wind turbine array
[DE88-001103] N88-18063
Modal testing the EOLE
[DE88-003795] N88-18066
Preliminary results from the dynamic response testing of the Westinghouse 600-kW wind turbine
[DE88-001123] N88-18070
Modal testing of a very flexible 110 m wind turbine structure
[DE88-003796] N88-18072
Analysis of wind turbines on offshore support structures excited by random wind and random waves
[DE88-004772] N88-18074
Turbulence loads on the Howden 26-m-diameter wind turbine
[TI88-001116] N88-18075
WIND VELOCITY
NASA wind shear model: Summary of model analyses N88-17617
WINDPOWER UTILIZATION
Cape Blanco wind farm feasibility study
[DE88-003748] N88-18059
WINDPOWERED GENERATORS
Study on a rotor speed control system for a horizontal axis windmill
[NAL-TR-931] N88-18062
WING LOADING
Reduction of tilt rotor download using circulation control N88-17605
WINGS
Solution of the three-dimensional Navier-Stokes equations for transonic flow using a multigrid method N88-17579
A transonic-small-disturbance wing design methodology
[NASA-TP-2806] N88-17614
The intelligent wing, Aerodynamic development direction for future passenger aircraft
[MBB-UT-006/87] N88-17848
WINTER
Systematic errors of the FSU global spectral model N88-18103
WORDS (LANGUAGE)
A two-stage isolated-word recognition system using discriminant analysis
[AD-A187425] N88-18360
WORK CAPACITY
Cardiovascular and subjective measures of task demand in a low workload monitoring task
[REPT-8804] N88-18176
WORKLOADS (PSYCHOPHYSIOLOGY)
Trends in the distribution of tasks between commercial pilots and flight control systems
[MBB-UT-008/87] N88-17851
Second All-Union Conference on Physiology of Extreme States and Individual Protection of Man N88-18147
Cardiovascular and subjective measures of task demand in a low workload monitoring task
[REPT-8804] N88-18176
WORKSTATIONS
Signal processing studies program VLSI designs for unary functions
[AD-A188053] N88-17922
Shared workspaces for real-time collaboration in distributed networks: Concepts, techniques, problems
[AD-A188150] N88-18315

X

X RAY ANALYSIS
High-resolution X-ray microstructural study of single crystals of YBa2Cu3O/sub 7-y/
[DE88-004856] N88-18484
X RAY ASTRONOMY
AXAF: The Advanced X-ray Astrophysics Facility
[NASA-EP-251(M)] N88-17725
X RAY ASTROPHYSICS FACILITY
AXAF: The Advanced X-ray Astrophysics Facility
[NASA-EP-251(M)] N88-17725
X RAY DIFFRACTION
High resolution electron and ion microscopy
[AERE-R-12502] N88-17754
X RAY LASERS
Spatially resolved X-ray laser spectra and demonstration of gain in nickel-like systems
[DE88-003957] N88-17979
Research studies on extreme ultraviolet and soft X-ray lasers
[AD-A187506] N88-17996
X RAY SCATTERING
Grazing incidence X-ray scattering study of defect structures in MBE GaAs/Si using synchrotron radiation
[DE88-004556] N88-18483
X RAY SPECTRA
Spatially resolved X-ray laser spectra and demonstration of gain in nickel-like systems
[DE88-003957] N88-17979
X RAY SPECTROSCOPY
Durability and damage tolerance of aluminum castings
[AD-A188444] N88-18013
X RAYS
The measurement of chemical compositon with high spatial resolution using a dedicated scanning transmission electron microscope
[AERE-R-12317] N88-17753
Suppression of X-rays generated by runaway electrons in ATF
[DE88-004179] N88-18440
Effects of X irradiation and high field electron injection on the electrical properties of rapid thermal oxides
[DE88-002642] N88-18461
The origin of the diffuse X-ray background and the formation of galaxies and voids N88-18527
X WING ROTORS
Proceedings of the Circulation-Control Workshop, 1986
[NASA-CP-2432] N88-17586
Analysis of a fixed-pitch X-wing rotor employing lower surface blowing N88-17602
Prediction of aeroelastic response of a model X-wing rotor N88-17603
X-wing potential for Navy applications N88-17604
X-29 AIRCRAFT
X-29A forward-swept-wing flight research program status
[NASA-TM-100413] N88-17644
XV-15 AIRCRAFT
Using frequency-domain methods to identify XV-15 aeroelastic modes
[NASA-TM-100033] N88-17646

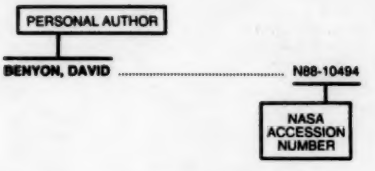
Y

YAG LASERS
Airborne Doppler lidar detection of wind shear. Results of performance analysis N88-17627
YTTERBIUM
Ytterbium monolayer diffusion barriers at Hg(1-x)Cd(x)Te/Al junctions
[AD-A188013] N88-17768
YTTRIUM OXIDES
Advanced materials for solid oxide fuel cells
[DE88-002338] N88-18071
The structure and properties of twin boundaries in superconducting YBa2Cu3O7
[DE88-003864] N88-18468
Improved magnetization for YBa2Cu3O/sub 7-delta annealed in oxygen above 1000 C
[DE88-003934] N88-18469
Freestanding films of YBa2Cu3O/sub 6.9/
[DE88-003995] N88-18471
Grain boundaries, planar defects and superconducting properties of YBa2Cu3O7
[DE88-003477] N88-18475
Superconducting properties and structural characterization of high T/sub c/ oxides
[DE88-003479] N88-18477
Penetration depth measurements of YBa2Cu3O/sub 7-delta/ at 4 MHz
[DE88-003493] N88-18478
The electronic structure of YBa2Cu3O/sub 7-delta/ above and below T/sub c/
[DE88-003495] N88-18479
Simulation and processing of high resolution images of defects and interfaces in superconducting YBa2Cu3O7
[DE88-003856] N88-18480
High-resolution X-ray microstructural study of single crystals of YBa2Cu3O/sub 7-y/
[DE88-004856] N88-18484

Z

ZIRCONIUM ALLOYS
Diffusion studies in amorphous NiZr alloys
[DE88-003009] N88-17781
ZIRCONIUM OXIDES
Advanced materials for solid oxide fuel cells
[DE88-002338] N88-18071

Typical Personal Author Index Listing



Listings in this index are arranged alphabetically by personal author. The NASA accession number denotes the number by which the citation is identified.

A

ABBOTT, CHARLES E. N88-18112
ABDELWAHAB, HUSSEIN M. N88-18315
ABE, F. N88-17785
ABE, H. N88-18420
ABED, EYAD H. N88-17915
ABRAHAM, S. G. N88-18317
ABRAMOV, B. D. N88-18330
ABROSIMOV, S. V. N88-18124
N88-18126
N88-18138
ACCIOLY, A. J. N88-18090
ACKERMAN, J. L. N88-17800
ACKERMANN, R. A. N88-17949
ACKLEY, STEPHEN F. N88-18119
ACREE, C. W., JR. N88-17646
ADAMS, R. M. N88-17654
ADAMSON, PAT N88-17628
ADLER, PHILIP N. N88-17749
AFGAN, N. N88-17928
AGRAWAL, DHARMAR P. N88-18191
AHUJA, SUDHIR N88-18201
AINSWORTH, R. W. N88-17962
AKASOFU, S. I. N88-18096
ALBRECHT, G. N88-17657
ALBRITTON, J. N88-18433
ALBUS, J. S. N88-17999
ALEKSEYEV, YE. I. N88-18156
ALEXANDER, C. J. N88-18546
ALEXANDER, D. J. N88-17790
ALEXANDER, JAMES C. N88-18521
ALFANO, ROBERT R. N88-18411
ALFORD, WILLIAM R. N88-18177
ALLAN, S. J. N88-18208
ALLEN, J. J. N88-18368
ALLEN, J. M. N88-17924
ALLEN, J. W. N88-18073
ALLEN, KEITH R. N88-18235
ALLEN, MARK GARRISON N88-17933
ALLEN, T. R. N88-18276
ALLISON, M. A. N88-17765
ALONSO, RAFAEL N88-18216
ALPATOV, A. M. N88-18125
ALTMAN, NEAL N88-18291
ALTMANN, KONRAD N88-17837
ALYAKRINSKIY, B. S. N88-18151
AMER, HASSANEIN H. N88-17921
ANDERS, G. N88-17682
ANDERSON, M. S. N88-18232
ANDERSON, PAUL N88-18303
ANDERSON, SHAWN DAVID N88-17934
ANDONG, LIU N88-17751
ANDRETSOV, V. A. N88-18138
ANDREWS, DOROTHY M. N88-18243
ANDRIYENKO, YU. I. N88-18169
ANTONIADIS, DIMITRI A. N88-17923
ARAUJO, MYRIAN N88-17743
ARBOUZ, NASSIM M. N88-18009
ARBUZOV, B. A. N88-18547
ARGON, A. S. N88-18481
ARTAMONOVA, N. P. N88-18152
ARTHUR, E. D. N88-17985
ARTSRUNI, G. G. N88-18166
ARTZ, R. N88-18079
ARVIDSSON, E. N88-17884
ASANO, K. N88-17700
ASANO, T. N88-18477
ASHBY, S. F. N88-18342
ATTENBERGER, S. E. N88-18424
AUBRY, NADINE N88-17578
AUGUST, RICHARD N88-18036
AVERBACK, R. S. N88-17781
AVRAM, FLORIN N88-18371
AXE, J. D. N88-18484
AXELROD, T. S. N88-18530
AYDARALIYEV, A. A. N88-18165
AYRES, V. N88-17898
AZGALDYAN, N. R. N88-18166
AZIZ, M. J. N88-18327

B

BABUSKA, I. N88-18347
N88-18356
BABUSKA, IVO N88-18041
BABUSKA,, IVO N88-18348
BADER, CLAYTON H. N88-17731
BADIEY, MOHSEN N88-18112
BAFI, A. S. N88-18501
BAILEY, J. A. N88-18006
BAITY, F. W. N88-17883
BALTAKIS, F. P. N88-17924
BAME, S. J. N88-18546
BANAN, MOHSEN N88-17784
BANDY, R. N88-17773
BANKS, H. T. N88-18346
BANSIL, A. N88-18454
BARAM, YORAM N88-18320
N88-18366
BARANSKI, S. N88-18153
BARAS, J. S. N88-18321
N88-18324
N88-18351
BARBACCI, MARIO R. N88-18224
BARBAST, A. N88-18154
BARCHET, W. R. N88-18060
BARCILON, V. N88-18118
BARCILON, VICTOR N88-18117
BARKER, T. W. N88-18101
BARNARD, J. J. N88-18435
BARNES, S. L. N88-18092
BARREAU, R. N88-17682
BARRON, EMMANUEL N. N88-18357
BARTH, TIMOTHY J. N88-17592
BARTHELME, NEAL N88-17691
BARTON, B. D. N88-18006
BASKO, M. M. N88-17756
N88-17757
BATES, J. L. N88-18071
BATTEZZATO, L. N88-17670
BAUGHMAN, R. J. N88-18449
N88-18469
N88-18471
BAYLISS, A. N88-18329
BEASLEY, C. O. N88-18424
BEATTIE, C. A. N88-18354
BEAUD, P. N88-18403
BECK, M. N88-17993
BECK, R. N. N88-18017
BELKANIYA, G. S. N88-18162
N88-18171
BELLAMY, B. A. N88-17754
BELLINA, JOSEPH N88-17694
BELLOWS, ALFRED H. N88-17702
BENEDEK, R. N88-18454
BENJANNET, HASSINE N88-18072
BENNETT, D. P. N88-18535
BENNETT, G. A. N88-17909
BENNETT, JOHN N88-17913
BENNETT, M. J. N88-17779
N88-18026
BENOUEZDOU, MONGI N88-18030
BENOVA, D. K. N88-18155
BENSOUSSAN, A. N88-18324
N88-18351
BENZIGER, JAY N88-17972
BERENSTEIN, CARLOS A. N88-18355
BERK, HERBERT L. N88-18419
BERKOVITS, A. N88-18040
BERLIN, A. A. N88-18135
BERNHARD, R. J. N88-18376
BERNSTEIN, CARLOS A. N88-18352
BERRY, M. N88-18288
BERRY, R. S. N88-18500
BEVILAQUA, PAUL M. N88-17599
BHARATHAN, D. N88-18069
BHATTACHARYA, A. N88-17624
BHAVNANI, SUSHIL HIROO N88-17935
BHUYAN, L. N. N88-18203
BIGGERS, JAMES C. N88-17604
BILLDAL, JAN TORE N88-17675
BIONOV, J. N88-18154
BIONTA, R. M. N88-18402
BIRDSALL, C. K. N88-18381
N88-18437
BIRKBECK, J. C. N88-18006
BJOERN, L. N88-17703
BLAHA, GEORGES N88-18054
BLAKE, DONNA W. N88-18116
BLOECKER, U. N88-17674
BLOOM, G. H. N88-18005
BOCHNAK, J. N88-18335
BODEN, T. A. N88-18510
BOELKOW, LUDWIG N88-17820
BOENI, P. N88-18465
BOGDONOFF, SEYMOUR M. N88-17961
BOLDMAN, DONALD R. N88-17686
BOLT, S. E. N88-17790
BONAFE, J. L. N88-17620
BONAR, JEFFREY G. N88-18295
BONNER, B. E. N88-18390
BONSALL, CHARLES A. N88-17711
BORISOV, G. I. N88-18126
BORRETT, V. T. N88-17973
BOUCHET, F. R. N88-18535
BOUSQUET, J. M. N88-17669
BOWLES, ROLAND L. N88-17616
N88-17618
BOWMAN, C. D. N88-18537
BOXER, S. G. N88-18057
BRABY, CAROLE D. N88-18176
BRADSHAW, P. N88-17583
BRANDT, JUERGEN N88-17839
BRAY, R. S. N88-17635
BREINIG, ARMIN N88-17864
BRENNING, NILS N88-18414
BRENT, G. A. N88-18282
BRESLAV, I. S. N88-18164
BREUGELMANS, F. A. E. N88-17672
BREVNOV, N. N. N88-18412
BREWER, D. W. N88-18272
BREWER, E. D. N88-17818
BRIDGMAN, H. N88-18079
BRIEHL, DANIEL N88-17728
BRIGGS, G. A. D. N88-18027
BRITT, CHARLES L. N88-17625
BROCHET, J. N88-17681
BRODSKY, M. B. N88-18451
BROICHHAUSEN, K. D. N88-17652
BROOKES, N. N88-18479
BROUWER, RANDALL JAY N88-18289
BROWER, SHARON N88-17699
BROWN, ALISON N88-18517
BROWNE, J. C. N88-18365
BROWNE, M. N88-17897
BRUBAKER, K. L. N88-17812
BRUCKNER, L. A. N88-18359
BRUN, G. N88-17663
BRYCE, J. D. N88-17658
BSCHORR, OSKAR N88-17841
BUCHANAN, BRUCE G. N88-18323
BUCHER, I. Y. N88-18265
BUCHNER, M. N88-18335
BUCK, KURT R. N88-18119
BUDKO, A. B. N88-17756
N88-17757

BUELOW, STEVEN J. N88-18387
BUGROV, S. A. N88-18123
BURAVKOVA, L. B. N88-18139
BURCH, S. F. N88-18014
BURG, M. N88-18154
BURGESS, ERIC N88-18084
BURKE, J. J. N88-17892
BURKE, J. R. N88-18258
BURNETT, P. J. N88-17798
BURNS, BRENT EMIL N88-17965
BURSHEARS, M. N88-17762
BUTLER, DAN N88-17712
BUTOW, STEVEN J. N88-17695
BUTTLE, D. J. N88-18027
BYRNE, JOHN H. N88-18316

C

CALO, J. N88-17760
CAMPBELL, EDWARD J. N88-18387
CAMPBELL, RICHARD L. N88-17614
CANAVAN, G. H. N88-18365
CANN, D. C. N88-18208
CANN, GORDON L. N88-17732
CANRIGHT, SHELLEY N88-17690
CANTRELL, BEN N88-17894
CAPONE, D. W. N88-18450
CAPRILE, C. N88-18487
CARBAUGH, DAVE N88-17631
CARDOSO, J. C. B. R. N88-17775
CAREY, R. P. N88-18024
CARLSON, CURTIS RAY N88-18069
CARLSTEN, B. E. N88-17975
N88-17983
CARNE, T. G. N88-18066
N88-18072
CARNES, J. R. N88-17766
CARR, JOHN E. N88-17606
CARRERAS, B. A. N88-18441
CARROLL, JOHN M. N88-18303
CARTER, C. B. N88-17808
CASKEY, G. R., JR. N88-17789
CASPERSON, DONALD E. N88-17988
CASSIDY, R. T. N88-17792
N88-18006
CHAMIS, CHRISTOS C. N88-17744
N88-17745
CHAN, K. C. D. N88-17983
CHANDRAN, SHARAT N88-17640
CHANDRASEKHAR, S. N88-17784
CHANG, S. N88-17768
N88-18487
N88-18488
N88-18490
N88-18491
CHAPPELL, DAVID C. N88-17729
CHAUMONT, D. N88-18120
CHAUVIN, J. N88-17677
CHEKANOVA, S. L. N88-18135
CHEN, C. H. N88-18388
N88-18391
CHEN, J. N88-18479
CHEN, M. Q. N88-18309
CHEN, S. S. N88-17946
CHEN, W. N88-18285
CHEN, WEN-JENG N88-18002
CHEN, YIH-FARN N88-18294
CHENG, R. S. N88-18194
CHEONG, HOICHI N88-18308
CHERDANTSEVA, YE. M. N88-18127
CHERNOOK, T. B. N88-18165
CHIEN, JAMES C. N88-17797
CHOE, J. Y. N88-17898
CHOI, H. N88-17926
CHOI, SEO WON N88-17936
CHOPRA, INDERJIT N38-17600
CHOPRA, O. K. N88-17774
CHOU, Y.-M. N88-18185
CHOW, SIU-LUN N88-18031
CHRISTENSEN, S. W. N88-18510
CHRISTIANSON, C. C. N88-18064
CHU, M. Y. N88-18468
CHUBB, T. A. ..... N'88-18100
CHUKHNO, E. I. N88-18142
CHUNG, H. M. N88-17774
CHUNG, M. J. N88-18227
CHUNG, T. J. N88-17733
CIARLO, D. R. N88-18455
CIESNIK, M. N88-18048
CLANCEY, WILLIAM J. N88-18323
CLARK, G. N88-17735
N88-17873
COBBLE, JAMES A. N88-17988
COFFEY, HELEN E. N88-18544
N88-18545
COHEN, B. I. N88-18381
COHEN, ELAINE N88-18293
COLEMAN, R. G. N88-17968
COMBI, MICHAEL R. N88-18540
CONNOLLY, K. N88-18287
CONSTANTIN, P. N88-18118
COOK, GEORGE E. N88-17869
COOK, K. V. N88-17790
COOK, ROBERT P. N88-18193
COOPER, D. E. N88-17601
CORBETT, JOHN D. N88-18295
CORDERMAN, R. R. N88-18478
CORNELIUS, KENNETH C. N88-17589
CORWIN, ROBERT F. N88-18113
N88-18114
CORWIN, W. R. N88-17790
COTE, G. O. N88-17794
COULON, J. P. N88-17908
COX, D. E. N88-18477
CRABTREE, G. W. N88-18445
N88-18450
CRAGNOLINO, G. N88-17787
CRAMER, J. G. N88-18497
N88-18536
CRAWLEY, R. L. N88-18429
CREMERS, D. A. N88-17987
CREUTZBERG, F. N88-17701
CREWS, J. H. N88-17737
CROCKETT, THOMAS W. N88-18299
CROMWELL, R. N88-17896
CRONISE, RAYMOND J., IV N88-17698
CUNNIFF, ROSS N88-18538
CUNNINGHAM, ROBERT E. N88-18295
CURTIS, L. J. N88-18392
CUSHMAN, R. N88-18336
CZARNEK, R. N88-17748

D

DAHLBURG, J. P. N88-18413
DAHLBURG, R. B. N88-18413
DALE, V. H. N88-18510
DALY, RUTH A. N88-18527
DARTSMELIYA, V. A. N88-18162
N88-18171
DAS, T. P. N88-18259
DASGUPTA, P. N88-18206
DASH, S. M. N88-17588
DASH, SANFORD M. N88-17593
DAUKAS, J. C. N88-18429
DAVIDSON, E. S. N88-18275
DAVIE, N. T. N88-18034
DAVIES, G. N88-18014
DAVIS, G. D. N88-17794
DAVIS, LARRY S. N88-17640
DAVIS, T. A. N88-18275
DAVYDOV, B. I. N88-18168
DAW, M. S. N88-18473
DAWSON, D. M. N88-17736
DAY, D. E. N88-17742
DAZAKOS, D. N88-18363
DEADMORE, DANIEL L. N88-17796
DEEPAK, A. N88-18106
DEGREZ, G. N88-17959
DEHOOP, A. T. N88-17886
N88-17951
DEJONGHE, L. C. N88-18468
DELP, EDWARD J. N88-18209
DELPOUX, M. N88-18154
DELVIN, W. L. N88-18359
DEMAINE, P. A. D. N88-18248
DEMENTHON, DANIEL N88-17640
DEMIN, A. N. N88-18162
N88-18171
DEMIN, N. N. N88-18172
DENG, Z. N88-17993
DENGLER, HARALD N88-17840
DERSTINE, MATTHEW N88-18268
DESAI, B. C. N88-18205
DESANTI, O. N88-18120
DESAULTY, M. N88-17663
DESTUYNER, R. N88-17682
DEVAN, W. R. N88-18440
DIAMOND, P. H. N88-18441
DICKENSON, SVEN J. N88-17640
DICKEY, JOHN R. N88-17919
DILLICH, SARA A. N88-17793
DIMARZO, M. N88-17950
DITTERS, E. J. N88-18339
DITTMAR, JAMES H. N88-18379
DIVSALAR, DARIUSH N88-17891
DIXIT, S. N. N88-17977
DJEU, N. N88-17998
DODSON, B. W. N88-18470
DOEKMECI, M. C. N88-18460
DOEPKESS, J. N88-17696
DOMINIC, K. N88-17762
DONGARRA, J. J. N88-18287
DONLAN, B. N88-18247
DOPHER, ROBERT N88-17603
DORSEY, GEORGE L. N88-17705
DORSINVILLE, ROGER N88-18411
DOUGLAS, MICHAEL WILLIAM N88-18102
DOUP, T. M. N88-18281
DOVLATYAN, R. A. N88-18166
DOWELL, MICHAEL N88-18238
DUCHENE, GLENN A. N88-17702
DUCK, P. W. N88-17955
DUDNIKOV, V. G. N88-18278
DUFAU, J. N88-17651
DUH, JAMES E. N88-17603
DUNLAP, B. D. N88-18445
N88-18451
DUNN, M. G. N88-17654
DUNNING, T. H., JR. N88-17755
DURFEE, R. C. N88-18505
DURGIN, W. D. N88-17697
DURNOVA, G. N. N88-18128
N88-18144
N88-18158
DVORAK, F. A. N88-17588
DVORAK, FRANK A. N88-17593
DVORAK, GEORGE J. N88-17746
DWIGHT, A. E. N88-18451

E

EADES, R. A. N88-17755
EASLER, T. E. N88-17752
EASTMAN, L. F. N88-18444
EBERLE, C. C. N88-18440
ECKART, M. J. N88-17979
EDMOND, R. D. N88-18095
EDWARDS, THOMAS J. N88-18296
EFE, KAMAL N88-18211
EGECIOGLU, OMER N88-18328
EGGERT, GEOFFREY MARK N88-17780
EGUCHI, KUNIHISA N88-17769
EICHMANN, GEORGE N88-18411
EISA, GABER FAHEEM N88-17784
EKBOM, LARS N88-17817
ELLINGSON, W. A. N88-17800
ELLIOTT, C. JAMES N88-17974
ELMOGARMID, A. K. N88-18220
ENDEKA, D. K. N88-18124
N88-18126
ENENKEL, BERNHARD N88-17854
ENGLAND, A. C. N88-18440
ENGLAR, ROBERT J. N88-17608
EPPEL, JOSEPH C. N88-17609
EPPLER, RICHARD N88-17821
ESTLER, R. C. N88-18408
ETTINGER, GIL J. N88-18322
EWALD, J. N88-17689

F

FABER, KATHERINE T. N88-17795
FABIAN, HANS N88-17827
FAETH, G. M. N88-17960
FALCHETTI, F. N88-17681
FANG, ZHIXI N88-18311
N88-18313
FANSELOW, J. L. N88-18523
FANT, DANIEL BARTHOLEMEW N88-17937
FARRAR, H., IV N88-18190
FARRIS, RICHARD J. N88-17797
FATH, A. FREDRICK N88-18517
FATOOHI, RAAD A. N88-18301
FAURIE, JEAN-PIERRE N88-18486
FAYE, ROBERT E. N88-17605
FEAGIN, J. M. N88-18383
FEDERER, W. T. N88-18271
FEDOROV, V. P. N88-18168
FEDYAKIN, N. N. N88-17904
FELDMAN, D. W. N88-17975
FELKER, FORT F. N88-17605
FENDLER, J. H. N88-18065
FENDRICH, JOHN N88-18234
FENG, Z. D. N88-18271
FENNELL, ROBERT E. N88-17684
FERGUSON, GORDON J. N88-18298
FERNANDEZ, BENITO N88-18358
FERNANDEZ, KEN N88-17869
FERRAND, PASCAL N88-17673
FIELD, B. F. N88-17905
FIGUEROALOPEZ, HUMBERTO GLODULFO T. N88-18421
FILENKO, V. YE. N88-18162

FILL, JAMES A. N88-18361
N88-18362
FINLAY, WARREN HUGH N88-17938
FINLEY, P. N88-18050
FISCHER-COLBRIE, A. N88-18483
FISCHER, J. N88-17969
FISCHER, RAINER N88-17861
FISHER, ALAN D. N88-18373
FITZGERALD, JOHN N88-18517
FLEISCHBEIN, JANE N88-18111
FLEMING, R. M. N88-18465
FLETCHER, EDWARD A. N88-18077
FOERSTER, K. M. N88-17660
FOILES, S. M. N88-18473
FORBES, MICHAEL FREDRIC N88-18374
FORTUNATO, RONALD C. N88-17710
FOWLER, R. H. N88-18428
FOX, G. C. N88-18263
FRADIN, C. N88-17661
FRADIN, F. Y. N88-18451
FRAMPTON, P. H. N88-18502
FRANCIOSI, A N88-18491
FRANCIOSI, A. N88-17768
N88-18487
FRANCISCO, G. N88-18458
FRANK, D. J. N88-17720
FRANKE, M. E. N88-17596
FRANKLIN, JANET N88-18049
FRANZ, HORST E. N88-17840
FRAUNDORF, P. B. N88-17792
FREEMAN, A. J. N88-18453
FREEMAN, SCOTT J. N88-18188
FREY, A. N88-18263
FREY, MARY ANNE BASSETT N88-18177
FRIEDMAN, REVA N88-18255
FRIEDRICH, OSKAR N88-17842
FRIEMAN, E. A. N88-17952
FRINK, STEPHEN H. N88-18512
FRITSCHEN, LEO J. N88-18097
FROESEFISCHER, C. N88-18389
FU, W. N88-18471
FUCHS, J. M. N88-18063
FUCHS, R. N88-17680
FUJII, KOZO N88-17584
FUJIKAWA, KAZUO N88-18367
FUJIMURA, R. K. N88-17765
FUJITA, S. N88-17700
FULLER, C. A. N88-18125

G

GAJULAPALLI, SURESH N88-17640
GALLIVAN, K. N88-18274
GALLOPOULOS, E. N88-18328
N88-18340
GALLUS, H. E. N88-17652
GALUSTYAN, M. V. N88-18171
GANGLOFF, RICHARD P. N88-17782
GAO, GUANG R. N88-18254
GAO, XIN-HAI N88-18086
GARCIA, K. K. N88-17994
GARCIA, L. N88-18441
GARNER, F. A. N88-17785
GARRIDO, L. N88-17800
GARSHNEK, VICTORIA N88-18175
GARWOOD, K. R. N88-17649
GASSET, G. N88-18154
GATTI, E. N88-17907
GATTINGER, R. L. N88-17701
GAUBIN, Y. N88-18154
GAVALI, SHARAD N88-17584
GAZENKO, O. G. N88-18150
GEARHART, S. A. N88-18053
GEHRINGER, EDWARD F. N88-18225
N88-18228
GELDER, THOMAS F. N88-17686
GELMAN, B. L. N88-18136
GEMBIZKA, D. N88-18153
GENDREAU, THOMAS B. N88-18231
GENNERT, MICHAEL A. N88-18410
GENTRY, W. R. N88-18382
GEORGE, D. C. N88-17985
GEORGE, M. J. N88-17971
GEORGE, THOMAS F. N88-18395
GERRITY, T. R. N88-18149
GERY, M. W. N88-18095
GETZSCHMANN, A. N88-17719
GHIJSEN, W. J. N88-18338
GHOSH, A. K. N88-18472
GIAPINTZAKIS, J. N88-18451
GIBBS, D. N88-18465
GIBSON, J. S. N88-18272
GIBSON, ROBERT B. N88-17988
GIFFORD, DAVID K. N88-18273
GILMER, JOHN B., JR. N88-18197
GINLEY, D. S. N88-18449
N88-18469
N88-18471
GINOUX, J. J. N88-17959
GLENDINNING, G. N88-18433
GLOVER, HOWARD N88-17621
GODWIN, J. R. N88-17875
GOERZ, D. A. N88-18432
GOLDEN, KENNETH M. N88-18119
GOLDMAN, A. I. N88-18465
GOLDMAN, A. M. N88-18489
GOLDSTEIN, JOHN C. N88-17974
GOLUBCHIKOVA, Z. A. N88-18152
GOMEZ, A. J. N88-18066
N88-18072
GOMI, MITSUO N88-17769
GONIS, A. N88-18394
GOODWIN, LISA ANN N88-18177
GORDON, J. N88-17917
GORSHUNOVA, A. I. N88-18142
GOSLING, J. T. N88-18543
GOTTSTEIN, G. N88-17788
GOUTINES, MARIUS N88-17679
GOW, ANTHONY J. N88-18119
GRAHAM, C. N88-17659
GRASBERG, EH. K. N88-18526
GRASSI, F. N88-18496
N88-18532
GRAY, F. GAIL N88-18204
GRAY, L. J. N88-18327
GREEN, PETER E. N88-18242
GREENBERG, W. N88-18389
GREGORY, D. L. N88-17968
GREGORY, E. N88-18472
GREUB, H. N88-18247
GRIBOV, YU. V. N88-18412
GRIESER, F. N88-18448
GRIFFIN, C. W. N88-18071
GRIFFIN, O. HAYDEN, JR. N88-17738
GRIGORYEV, A. I. N88-18181
GRIMBERT, D. N88-17719
GRIMSHAW, ANDREW N88-18210
GRONEMEYER, S. N88-17800
GRONSKY, R. N88-18468
N88-18480
GROSCH, CHESTER E. N88-18301
GROSS, PHILIP N88-18517
GROSSFIELD, JOE N88-17706
GROSSMAN, R. N88-18012
GROVE, R. K. N88-17720
GRUNZE, M. N88-17810
GUAN, SHENG-UEI N88-18315
GUDIN, C. N88-18120
GUERDAL, ZAFER N88-17738
N88-18035
GUH, K. C. N88-18219
GUHA, ALOKE N88-18268
GUNDAPPA, MAHESH N88-17939
GUO, B. Q. N88-18348
GUO, Y. N88-17748
GUO, YIMING N88-18010
GUPTA, R. N88-18341
GUTOROVA, L. V. N88-18145

H

HAAKINSON, E. J. N88-17875
HADIMIOGLU, B. N88-17767
HAEMAELAEINEN, M. S. N88-18179
HAFF, P. K. N88-18375
HAGAN, W. K. N88-17952
HAGGERTY, J. S. N88-17906
HAHN, H. N88-17781
HAILEY, C. J. N88-17970
HALE, STEVEN N88-17641
HALL, DENNIS N88-18517
HALL, G. E. N88-17690
HALL, L. N. N88-18445
HALL, P. N88-17955
HALLOFF, E. N88-17740
HALME, S. J. N88-17881
HALPERN, J. B. N88-17989
HAN, S. P. N88-18309
HANATANI, K. N88-18428
HANDLER, F. A. N88-17726
HANERFELD, H. N88-18423
HANNSGEN, KENNETH B. N88-18353
HANZAWA, ASAO N88-18062
HARJES, MARK N88-18055
HARRIS, F. R. N88-17701
HARRIS, J. H. N88-17922
N88-18440
HARRIS, M. J. N88-17607
HARRIS, S. E. N88-17996
HARTMANN, F. X. N88-17994
HARVELL, J. K. N88-17598
HASHIDATE, MASATAKA N88-18062
HASHITANI, T. N88-17700
HATAYAMA, AKIYOSHI N88-18416
HATCHER, B. N88-18433
HAUSFELD, T. E. N88-18070
N88-18075
HAUSHALTER, R. J. N88-17966
HAVERTY, JACK N88-18517
HAY, J. L. N88-17901
HAYS, J. D. N88-18094
HAYTER, J. B. N88-18408
HE, SHUYUAN N88-18350
HEDRICK, J. K. N88-18358
HEINISCH, H. L. N88-17788
HEISE, OTHMAR N88-17856
HELAL, A. A. N88-18220
HELD, MANFRED N88-17861
HENDERSON, ROBERT E. N88-17648
HENNEY, D. A. N88-18505
HERAKOVICH, CARL T. N88-17738
HERBST, WOLFGANG B. N88-17843
HERDMAN, T. L. N88-18354
HERRMANNSFELDT, W. B. N88-18423
HEYDER, NORBERT N88-17852
HILBIG, REINHARD N88-17848
HINKLE, C. ROSS N88-18148
HINKS, D. G. N88-18445
N88-18450
HINRICHSEN, JENS N88-17850
HINTON, DAVID A. N88-17630
HIRSCH, M. D. N88-18513
HIRSCHEL, ERNST H. N88-17846
HIRSHMAN, S. P. N88-18424
HIRTH, JOHN P. N88-17795
HITT, E. F. N88-18022
HO, P. T. N88-17995
HO, Y. L. N88-18431
HOCK, S. M. N88-18070
N88-18075
HODEL, W. N88-18403
HOEGENAUER, ERNST N88-17857
HOENLINGER, HEINZ N88-17845
HOFFMAN, D. J. N88-17883
HOFFMANN, R. NICHOLAS N88-17706
HOFFMEYER, J. A. N88-17874
HOFMANN, I. N88-18372
HOGAN, W. J. N88-18434
HOLL, P. N88-17907
HOLLAND, G. F. N88-18468
HOLLINGSHEAD, J. R. N88-18018
HOLMBERG, B. N88-17740
N88-17741
HOLMES, J. F. N88-18052
HON, THON-LON N88-17958
HONDA, TSUTOMU N88-18418
HONG, CHANG-HO N88-17600
HONG, M. N88-18465
HOOKE, LYDIA RAZRAN N88-18175
HORN, JENNIFER R. N88-18004
HOSHINO, K. N88-17781
HOUGH, H. F. N88-17794
HOURMOUZIADIS, J. N88-17657
HOUSTON, J. E. N88-18463
HSIEH, T. C. N88-18465
HSU, PEI PEI N88-17940
HUANG, D. N88-18464
HUDDLESTON, J. N88-18014
HUDSON, B. N88-18026
HUETER, J. M. N88-18515
HUFF, J. R. N88-18520
HUFFAKER, R. MILTON N88-17627
HUGHES, R. J. N88-18498
HUME, M. W. N88-18358
HUMPHREY, B. N88-17871
HUMPHREY, W. S. N88-18290
HUNT, L. R. N88-18331
HUNT, R. D. N88-17690
HUOT, J. P. N88-17655
HURSON, A. R. N88-18220
N88-18249
HURST, J. J. N88-18477
HUTCHINSON, I. G. N88-18014
HUTCHINSON, R. A. N88-17945
HUYER, ADRIANA N88-18111

I

IBRAHIM, E. N88-18425
ICHIKAWA, TERUO N88-17613
IDA, TOSHIO N88-18417
IHM, Y. E. N88-18464
IIDA, HIROMASA N88-18418
ILYIN, YE. A. N88-18124
N88-18126

ILYINAKAKUYEVA, YE. I. N88-18128
N88-18157
N88-18158
IRWIN, MARY JANE N88-18195
ISAYEV, G. G. N88-18164
ISHII, M. N88-17928
ISKANDER, S. K. N88-17790
ISLER, R. C. N88-18438
ITO, K. N88-18346
ITZELSBERGER, GUENTHER N88-17835
IVANOV, V. V. N88-18131
IVANOVA, S. M. N88-18159

J

JACKSON, J. K. N88-18401
JAEGER, D. L. N88-17814
JAKUBOVICS, J. P. N88-18027
JALBY, W. N88-18274
JALUFKA, N. W. N88-18443
JAMES, M. R. N88-18321
N88-18324
JAMIESON, LEAH H. N88-18209
JAMISON, KEITH N88-17913
JANKOWSKI, A. F. N88-18402
JANSING, D. S. N88-18505
JAYARAM, MOHAN N88-17579
JAYARAMAN, BHARAT N88-18297
JAYASIMHA, D. N. N88-18306
JEANDEL, D. N88-17683
JEGLEY, DAWN C. N88-17739
JENDEN, P. D. N88-18093
JENNINGS, M. J. N88-17948
JENSEN, E. DOUGLAS N88-18192
N88-18257
JENSEN, REED J. N88-17988
JERNIGAN, T. C. N88-18440
JESCH, RAMON L. N88-17885
JESPERSEN, DENNIS C. N88-17592
JIANG, L. N88-18479
JIANG, O. N88-18248
JODIS, S. N88-18248
JOHNSON, D. D. N88-18394
JOHNSON, P. D. N88-18479
JOHNSON, RALPH E. N88-18213
JOHNSTON, ANNE DEPIANTE N88-18387
JOLLES, MITCHELL I. N88-18044
JONAH, C. D. N88-17751
JONAS, J. N88-18474
JONES, DAVID H. N88-17941
JONES, LARRY A. N88-17988
JORDAN, K. E. N88-18329
JOSS, W. N88-18445
JOST, D. N88-17982
JOUVELOT, PIERRE N88-18273
JUELS, RONALD J. N88-18242

K

KABAT, WALDO C. N88-18255
KAHANA, S. H. N88-18533
KALTSCHMIDT, HORST N88-17855
KAMATH, SUNDAR MANGALORE N88-18028
KAMEARI, AKIHISA N88-18417
KAMIGAKI, TAKAHIRA N88-17803
KAN, X. B. N88-18484
KANIA, D. R. N88-18433
KANTAK, ANIL N88-17890
KAPLAN, IAN N88-18207
KAPLAN, SIMON M. N88-18213
KAPLAN, T. N88-18327
KAPLANSKIY, A. S. N88-18128
N88-18158
KASAI, MASAO N88-18417
KASTANAKIS, GEORGIOS N88-17852
KAUFFMAN, R. N88-18433
KAUFFMAN, ROBERT E. N88-17758
KAYFADZHYAN, M. A. N88-18161
KAYMAZ, R. N88-17880
KAZA, KRISHNA RAO V. N88-18036
KEANE, C. J. N88-17979
KEENER, EARL R. N88-17596
N88-17597
KELLERER, HELMUT N88-17839
KELLOGG, G. L. N88-18463
KEMMER, J. N88-17907
KENNEDY, CHARLES M. N88-18517
KETO, J. W. N88-17981
KEVORKIAN, J. N88-17984
KHERANI, N. P. N88-17788
KIDA, TAKASHI N88-17730
KIGGUNDU, B. N88-17871
KILLEEN, T. L. N88-18098
KILLEN, ROSEMARY MARGARET N88-18539
KIM, J. S. N88-17910
KIMBALL, C. W. N88-18451
KINDSFATHER, R. R. N88-18440
KINGCOMBE, R. C. N88-17658
KINGLOFF, R. F. N88-17601
KINNE, STEFAN AUGUST N88-18087
KINO, G. S. N88-18021
KISZCZAK, K. N88-18415
KITAKOHJI, T. N88-17700
KITAMURA, S. N88-17700
KITCHENS, PHILIP H. N88-17707
KLAASSEN, W. N88-17882
KLAUSING, HELMUT N88-17855
KLAVINS, P. N88-18476
KLEIN, NATHAN N88-17815
KLEINMAN, R. E. N88-18337
KLEM, J. F. N88-18464
KLIMETZEK, F. N88-17671
KLIMOVITSKIY, V. YA. N88-18125
KLOEPPEL, VALENTI N88-17854
KLOP, J. W. N88-18334
KLOPFER, G. H. N88-18344
KNAUS, ARNIM N88-17844
KNEE, M. J. N88-17876
KNOCHE, HANS-GEORGE N88-17829
KOBER, WOODY N88-18055
KOC, CETIN K. N88-18328
KOEHLER, P. E. N88-18537
KOELLE, DIETRICH E. N88-17828
KOELLING, D. D. N88-18453
KOKOVA, N. I. N88-18153
KOMOLOVA, G. S. N88-18129
N88-18130
KONDRACHUK, A. V. N88-18132
KONG, JIN A. N88-17916
KONIGSFELD, KRIS GIBSON N88-18304
KONRACHUK, A. V. N88-18167
KOOIJ, B. J. N88-18377
KOPRIVA, A. J. N88-17759
KORNBLUM, H. N88-18433
KOROLKOV, V. I. N88-18124
KOROLKOV, V. V. N88-18126
KOROTAYEV, M. M. N88-18152
KORSUNSKIY, V. N. N88-18138
KORTRIGHT, J. N88-18483
KOSRO, MICHAEL P. N88-18111
KOTOVSKAYA, A. R. N88-18153
KOUL, R. N88-18318
N88-18319
KOURTIDES, DEMETRIUS A. N88-17743
KOZACZYNSKI, WOJTEK N88-18255
KRAIN, H. N88-17676
KRASNOKUTSKIJ, R. N. N88-17904
KRASNOV, I. B. N88-18141
KRASON, J. N88-18048
N88-18050
KREILICK, S. N88-18472
KRINSKY, S. N88-17990
KRISHNAPRASAD, P. S. N88-18011
N88-18012
N88-18042
KROLL, N. N88-17668
KRYLOV, YU. V. N88-18131
KU, H. C. N88-18476
KUBOTA, ETSUO N88-17803
KUCHARZ, W. N88-18335
KUHN, RICHARD N88-17581
KUHN, RICHARD E. N88-17585
KULL, ROBERT C., JR. N88-18373
KULP, M. N88-18462
KUMER, VIPIN N88-18241
KURCHANINOV, L. L. N88-17904
KUROCHKIN, YU. N. N88-18162
KUSHNER, L. N88-18083
KUSTOV, V. V. N88-18133
KUTZER, ANTS N88-17858
KUZNEZOVA-SHOLPO, IRINA N88-18325
KWAK, J. F. N88-18449
N88-18469
N88-18471
KWO, J. N88-18465
KWOK, ALEX YUEN-WAI N88-18261
KWOK, W. K. N88-18445
N88-18450
KYRALA, GEORGE A. N88-17988

L

LADERMAN, S. S. N88-18483
LAGNESE, JOHN E. N88-18025
LAGRAFF, J. E. N88-17962
LAKIN, K. M. N88-18485
LAM, D. J. N88-18484
LAMB, R. N. N88-17810
LAMBIOTTE, JULES J., JR. N88-18302
LAN, C. EDWARD N88-17612
LANDWEHR, CARL E. N88-18303
LANG, E. N88-18026
LANGER, S. N88-18433
LANGFELDER, HELMUT N88-17823
LARDELLIER, A. N88-17651
LARKIN, T. H. N88-17909
LARRAZA, ANDRES N88-17679
LARROUSSE, MARK N88-17784
LASINSKI, B. N88-18433
LASINSKI, THOMAS N88-18517
LAST, ISIDORE N88-18395
LAUDIEN, ECKEHARD N88-17841
LAUFFER, J. P. N88-18033
N88-18066
N88-18072
LAWRIE, D. H. N88-18314
LAWS, NORMAN N88-17746
LAZARUS, D. N88-18094
LEAF, G. K. N88-18326
LEBERL, FRANZ N88-18055
LEBLANCO, R. J., JR. N88-18206
LEE, ALFRED T. N88-17634
LEE, CHI H. N88-17995
LEE, CHIH-KUNG N88-18029
LEE, D. N88-18305
N88-18340
LEE, G. S. N88-18441
LEE, J. W. N88-18284
LEE, JOHN D. N88-17599
LEE, L. C. N88-18096
LEE, PETER H. Y. N88-17988
LEE, R. L. N88-18314
LEMPRIERE, B. M. N88-17688
LEONG, S. N88-18248
LESKOVAR, B. N88-17888
N88-17889
N88-17912
LEVEQUE, R. J. N88-18343
LEVERSUCH, N. P. N88-17658
LEVINE, S. N88-18475
LEVY, ALVIN N88-17749
LEVY, BERNARD C. N88-18380
LEWIS, J. S. N88-17664
LHEUREUX, J. M. N88-17720
LI, S. T. N88-17895
LI, Y. P. N88-17984
LI, YAO N88-18411
LICHTENBERGER, D. L. N88-18393
LIGHT, JEFFREY S. N88-17605
LILLY, W. N88-17760
LILLYA, C. P. N88-17797
LIN, C. L. N88-18479
LIN, KWEI-JAY N88-18245
LIN, YOW-JIAN N88-18241
LINDEN, ARTHUR W. N88-17604
LINDKVIST, L. N88-17703
LINKOUS, C. A. N88-17809
LINSTROM, GARY N88-18252
LINTZ, H. K. N88-18429
LIO, Y. L. N88-18364
LITCHFIELD, M. R. N88-17650
LIU, J. Z. N88-18484
LIU, JANE W. S. N88-18210
LLEWELLYN, E. J. N88-17701
LOBACHIK, V. I. N88-18124
N88-18126
N88-18138
LOBO, A. A. N88-18227
LOHMANN, D. N88-17668
LONGMIRE, M. S. N88-18399
LONGONI, A. N88-17907
LOOFT, F. J. N88-17697
LOTH, JOHN L. N88-17610
LOU, Y. K. N88-17926
LOVE, CHARLES M. N88-17678
LUBECK, O. M. N88-18266
LUCASSEN, JOHN M. N88-18273
LUDWIG, K.-P. N88-17689
LUETHY, W. N88-17982
LUMIA, R. N88-17999
LUMPKIN, A. H. N88-17975
LUND, P. D. N88-18067
LUND, THOMAS SCOTT N88-17929
LUNDSTROM, STEPHEN F. N88-18218
LUO, JIAN N88-18310
LUPTON, J. H. N88-17970
LUX, DAVID P. N88-17844
LYAMIN, V. R. N88-18152
LYATUSHINSKI, A. N88-18415
LYKE, S. E. N88-17945

M

MACAYEAL, DOUGLAS R. N88-18117

MACCORMACK, ROBERT W. N88-17587
MACGOWAN, B. J. N88-17979
MACKEN, NELSON A. N88-17956
MACLAINE-CROSS, I. L. N88-18069
MACLENNAN, BRUCE J. N88-18270
MACMILLAN, N. H. N88-17806
MADDOCKS, J. H. N88-18521
MADLAND, D. G. N88-17985
N88-17986
MADSEN, P. H. N88-18075
MAEL, DAVID N88-18446
MAILYAN, E. S. N88-18139
MAJKRZAK, C. F. N88-18465
MAKEL, DARBY B. N88-17732
MAKEYEVA, V. F. N88-18129
N88-18130
MAKOWIECKI, D. M. N88-18402
MAKSIMOV, A. L. N88-18165
MALONY, A. D. N88-18312
MANDREKAS, JOHN N88-18422
MANGUM, B. W. N88-17967
MANSOUR, MAHMOUD LOTAYEE N88-17930
MANWARING, M. L. N88-18253
MARABLE, W. P. N88-17997
MARGASON, RICHARD N88-17581
MARGLE, S. M. N88-18505
MARISKA, J. T. N88-18413
MARR, J. J. N88-18064
MARSDEN, J. E. N88-18042
MARSDEN, JERROLD E. N88-18012
MARSHALL, DAVID A. N88-18223
MARTIN-NEUVILLE, H. N88-18061
MARTIN, EDWARD A. N88-18360
MARTINEZ, M. J. N88-17927
MARTINEZ, R. N88-17871
MARTINOVIC, ZORAN NAUM N88-17683
MASAPATI, G. H. N88-18250
MASSALKHI, ZOUHEIR N88-18000
MASSIDDA, S. N88-18453
MASUYA, GORO N88-17770
MATIC, PETER N88-18044
MATLOCK, D. K. N88-17791
MATSON, D. F. N88-18063
MATTHEWS, D. L. N88-17979
MATYKIEWICZ, J. L. N88-18451
MAUGHAN, THOM N88-17708
MAUNEY, JON N88-18244
MCAULAY, ALASTAIR D. N88-18202
MCCAIN, H. G. N88-17999
MCCALLUM, R. W. N88-18476
MCCANN, M. P. N88-18388
N88-18391
MCCLAIN, FRED N88-18517
MCCLUSKEY, EDWARD J. N88-17921
MCCONNELL, MARK LEWIS N88-18522
MCCREDIE, B. D. N88-18312
MCDONALD, J. F. N88-18247
MCFARLAND, RICHARD E. N88-17645
MCGREGOR, PATRICK N88-18517
MCGUIRE, PATRICK JOHN N88-18260
MCKINNON, JOHN A. N88-18544
N88-18545
MCLACHLAN, B. G. N88-17595
MCMACKIN, I. N88-17993
MCNICHOLAS, K. N88-17659
MCSPARRON, D. A. N88-18401
MCVEY, BRIAN D. N88-17974
MCWHAN, D. B. N88-18465
MEADOR, J. L. N88-18253
MECKLINGER, ROLAND N88-17860
MEHDORN, HARTMUT N88-17847
MEHROTRA, RAVI N88-18228
MEIER, R. R. N88-18100
MEIER, U. N88-18274
MEISEL, D. N88-18448
MEISTER, DAVID N88-18189
MEL, BARTLETT W. N88-18267
MELTON, LYNN A. N88-17816
MENDIETA-JIMENEZ, JAVIER N88-17692
MENG, W. H. N88-17950
MENIKOFF, R. N88-17971
MENZEL, D. W. N88-18110
MERCHANT, H. N88-18247
MERIWETHER, J. W., JR. N88-18098
MERRITT, MARK W. N88-17632
MERZ, MARION P. N88-18177
MESSINA, P. C. N88-18262
MEUNIER, S. N88-17663
MEYER, F. W. N88-18384
MICHALSON, WILLIAM R. N88-18242
MIDDELDORP, A. N88-18334
MIDDLETON, DAVID N88-18299
MIDDLETON, S. P. N88-18445
MIELKE, ROLAND R. N88-18236
MIJNARENDS, P. E. N88-18454
MILES-MCDERMOTT, N. J. N88-18271
MILES, RICHARD B. N88-17714
MILLER, GORDON LYNN N88-18506
MILLER, J. F. N88-18064
MIMURA, KAZUKI N88-18493
MIROSHNIKOVA, YE. B. N88-18134
MISCHEL, C. N88-17661
MITCHELL, M. A. N88-18471
MITON, H. N88-17677
MIYOSHI, KAZUHISA N88-17801
MIZOGUCHI, TADANORI N88-18416
MODDEMAN, W. E. N88-17792
N88-18006
MODIN, A. YU. N88-18143
MOENIG, R. N88-17652
MOLENT, L. N88-18023
MOMOTA, HIROMU N88-18419
MONCHKA, D. N88-18415
MONTAGNE, J.-L. N88-18344
MOODENBAUGH, A. R. N88-18475
N88-18476
N88-18477
N88-18478
MOORE, C. F. N88-18397
MOORE, JAMES N88-17633
MOORE, ROYCE D. N88-17686
MOORE, S. W. N88-18404
MOOREEDE, M. C. N88-18125
MOREL, T. N88-17804
N88-17948
MOREY-HOLTON, EMILY N88-18174
MORITZ, A. G. N88-17973
MORKOC, H. N88-18464
MOROSIN, B. N88-18449
N88-18469
MORRIS, R. N. N88-18428
N88-18440
MORSE, E. C. N88-18381
MOSHIER, WILLIAM C. N88-17794
MOSIER, FRANCES L. N88-17691
MOSS, S. C. N88-18484
MOTH, D. A. N88-17772
MOURTOS, NIKOS JOHN N88-17580
MOUSTAPHA, S. H. N88-17655
MOZLEY, EDWARD C. N88-18113
N88-18114
MUCKERHEIDE, M. C. N88-17694
MUDGE, TREVOR N88-18226
MUKHERJEE, S. N88-18444
MULAC, W. A. N88-17751
MULCAHEY, T. P. N88-18064
MULCAHY, T. M. N88-17947
MULVANEY, P. N88-18448
MUNDY, J. N. N88-17799
MUNRO, J. K., JR. N88-17994
MURAKAMI, M. N88-18439
N88-18440
MUROTA, SHOICHI N88-18062
MURRAY, H. S. N88-18520
MURRAY, T. W. N88-17664
MURRELL, S. R. N88-18429
MURTHY, PAPPU L. N. N88-17745
MURTHY, V. R. N88-18300
MUTCHLER, G. S. N88-18390
MYRABO, LEIK N. N88-17914

N

NAASERI, M. N88-17583
NADEZHIN, D. K. N88-18526
NADIV, S. N88-18040
NAGLE-ESHLEMAN, JUDITH N88-18459
NAKAJIMA, S. N88-18420
NAKAMURA, M. N88-17888
N88-17889
NAMKUNG, W. N88-17898
NANSTAD, R. K. N88-17790
NATALE, A. A. N88-18529
NATARAJAN, SUBRA N88-18268
NAVIERE, HENRI N88-17679
NEGAHDARIPOUR, SHAHRIAR N88-18410
NEILL, P. H. N88-17750
NEILSON, G. H. N88-18440
NEKHAYEV, A. S. N88-18169
NEMOTO, H. N88-17700
NESENBERGS, M. N88-17874
NEUGEBAUER, M. N88-18546
NEUMYVAKIN, I. P. N88-18163
NEWMAN, GREGORY ALEX N88-18047
NG, Y. J. N88-18502
NI, LIONEL M. N88-18231
NICHOLS, J. H. N88-17607
NICHOLSON, D. M. N88-18394
NICHOLSON, JAMES N88-17699
NICHOLSON, M. M. N88-18078
NIEDERHOFER, KARL HEINZ N88-17862
NIELSEN, JACK N. N88-17586
NIETO, M. M. N88-18498
NIEVERGELT, J. N88-18315
NISHIKAWA, MASANA N88-18417
NISHIMURA, HIDEAKI N88-17963
NISHIO, SATOSHI N88-18417
NITSCHKE, FELIX N88-17840
NOACK, M. A. N88-18476
NODA, T. N88-17785
NOGAR, N. S. N88-18408
NOGUCHI, MASAYOSHI N88-18062
NOID, D. W. N88-17994
NOMURA, YASUYUKI N88-18419
NOSOVA, YE. A. N88-18141
NOVAK, CHARLES J. N88-17589
NOVAKOV, T. N88-18082
NULL, GEORGE W. N88-18524

O

OAKES, L. C. N88-17911
OBAYASHI, SHIGERU N88-17584
OBRIEN, H. A. N88-18537
OBRIEN, TOM N88-17699
ODONNELL, JOHN T. N88-18256
OEZBEK, ALI N88-18380
OH, Y. G. N88-18042
OHKAMI, YOSHIAKI N88-17730
OHNISHI, MASAMI N88-18419
OKAMOTO, MASAO N88-18419
OKAMOTO, OSAMU N88-17730
OKAPUU, U. N88-17655
N88-17662
OLAND, B. C. N88-17790
OLDEHOEFT, R. R. N88-18208
OLINTO, A. V. N88-18534
OLIVIER, DAVID A. N88-18115
OLSON, D. L. N88-17791
OLSON, R. J. N88-18510
OMAR, S. I. N88-18250
OMOHUNDRO, STEPHEN M. N88-18267
ONSTOTT, ROBERT G. N88-17623
OSBORN, J. N88-18356
OSCAR, D. S. N88-18074
OSTASHEVA, N. YE N88-18142
OTSUKA, N. N88-18464
OTTO, G. N88-17696
OWEN, D. B. N88-18185
OWEN, DEAN H. N88-18188
OWEN, J. R. N88-17901
OWENS, ROBERT MICHAEL N88-18195
OWSLEY, NORMAN L. N88-18269
OZELTON, M. W. N88-18013

P

PABST, OTTO E. N88-17831
PADGETT, W. J. N88-18364
PADOVA, C. N88-17654
PADUA, D. A. N88-18276
PAEZ, T. L. N88-18074
PAGE, EDWARD W. N88-18229
PAK, G. D. N88-18160
PALLANT, A. N88-18094
PANFEROVA, N. YE. N88-18145
PAPACHRISTOU, CHRISTOS A. N88-18246
PAPAZIAN, JOHN M. N88-17749
PARETZKE, H. G. N88-18385
PARGAS, ROY P. N88-18235
PARK, O. Y. N88-17733
PARSONS, J. M. N88-18069
PARTHASARATHY, R. N. N88-17960
PASHIN, S. S. N88-18142
PATEL, J. H. N88-18317
PATTERSON, J. N88-18287
PATUREAU, J. P. N88-18061
PAUL, J. N88-18023
PAYNE, M. G. N88-18388
N88-18391
PEARCE, J. G. N88-17901
PERALTA-FABI, RICARDO N88-17692
PERRING, J. K. N88-18014
PETERMAN, D. J. N88-18490
PETERS, DAVID L. N88-17718
PETTY, JAMES S. N88-17648
PFITZNER, MICHAEL N88-17859
PHILIP, P. N88-17768
N88-18487
N88-18488
N88-18490
PHILLION, D. N88-18433
PHILLIPS, G. C. N88-18390
PHILLIPS, JOHN L. N88-18035
PHILLIPS, PAMELA S. N88-17614

PHILPOT, M. G. N88-17650
PIANEZZI, B. N88-18154
PICRAUX, S. T. N88-18470
PIERCE, T. E. N88-18104
PIGEAUD, A. N88-18058
PINSKI, F. J. N88-18394
PIOLINE, D. N88-18120
PITTS, WILLIAM C. N88-17743
PIZZARELLO, F. A. N88-18078
PLANEL, H. N88-18154
PLEITEZ, V. N88-18529
PODSHIVALOV, A. A. N88-18131
POEPPEL, R. B. N88-17752
POGUTSE, I. O. N88-18412
POKER, D. B. N88-18407
POLYAKOV, B. I. N88-18146
POLYCHRONOPOULOS, C. D. N88-18307
PONCHAK, GEORGE E. N88-17860
PONOMARENKO, V. A. N88-18123
POPOV, V. I. N88-18138
POPOVA, I. A. N88-18170
N88-18181
PORTER, W. P. N88-18081
POSE, R. N88-18232
POSPISCHIL, OTTOKAR N88-17834
POST, D. N88-17748
POST, DANIEL N88-18043
POWER, W. H. N88-17883
PRAGER, S. C. N88-18431
PRASAD, R. N88-18454
PRATER, S. A. N88-18022
PREM, HORST N88-17833
PRESTON, R. F. N88-17736
PRIDDY, T. G. N88-17968
PRITCHARD, DAVID E. N88-18396
PROCASSINI, R. J. N88-18381
PROCTOR, FRED N88-17617
PRODAN, N. G. N88-18144
PRZYBYLLNSKI, STANLEY M. N88-18214
PULLIAM, THOMAS H. N88-17592
PURSER, A. N88-17736
PUTVINSKIJ, S. V. N88-18412

Q

QIU, S. L. N88-18479
QUARTERONI, ALFIO N88-18345
QUATE, C. F. N88-17767

R

RACHEV, SVETLOZAR T. N88-18325
RADEKA, V. N88-17907
N88-17969
RADZEWICZ, C. N88-17993
RAEMER, H. R. N88-17624
RAHAMAN, M. N. N88-17742
RAHGAVAN, R. N88-17624
RAISANEN, A. N88-17768
N88-18488
N88-18490
N88-18491
RAJU, I. S. N88-17737
RAKHMANOV, A. S. N88-18162
RAMAMOORTHY, C. V. N88-18294
RAND, ROBERT S. N88-18056
RANELLETTI, J. E. N88-18283
RANEY, STEVEN D. N88-18223
RAO, KUDITIPUDI VENKATRAM N88-17942
RAPPAPORT, S. A. N88-18525
RASKE, D. T. N88-18037
RASMUSSEN, D. A. N88-18440
RAY, GLEN N88-17709
RAYMER, M. G. N88-17992
N88-17993
RAZINKIN, S. M. N88-18133
RAZUVAEV, E. A. N88-18547
REDDY, J. N. N88-17747
REED, D. A. N88-18312
REEDY, R. C. N88-18541
REGAN, JANICE N88-18085
REHAK, P. N88-17907
REICHERT, GUENTER N88-17825
REISER, C. N88-17978
REISMAYR, DIETER N88-17865
RESCIA, S. N88-17907
REYBILLET, M. N88-18061
RHINE, WENDELL E. N88-17758
RIBAUD, Y. N88-17661
RICHMOND, G. N88-17976
RICKERBY, D. S. N88-17798
RICKS, E. L. N88-18186
RIDDLE, DENNIS W. N88-17609
RIEDEL, UWE N88-17689
RIESENFELD, RICHARD F. N88-18293
RIESS, W. N88-17674
RIVIERE, J. C. N88-17776
RIZNIC, J. N88-17928
ROBERTS, JEFFREY P. N88-17988
ROBERTS, LEONARD N88-17590
ROBINSON, A. P. N88-17877
ROBINSON, G. C. N88-17790
ROBISON, ARCH D. N88-18267
RODELLAR, R. N88-17653
RODEMAN, R. N88-18034
RODIONOV, O. N. N88-18136
RODRIGUEZ, G. N88-18008
ROEHRIG, H. N88-17897
ROELKE, RICHARD J. N88-17656
ROGERS, ERNEST O. N88-17602
ROGERS, H. E. N88-17659
ROGERS, J. D. N88-18018
ROGO, CASIMIR N88-17656
ROLPH, G. N88-18079
ROMANOV, YE. M. N88-18152
ROMANOV, YU. I. N88-18400
ROME, J. A. N88-18424
N88-18428
ROSEN, E. N88-17755
ROSENZWEIG, PATRICIA N88-18528
ROSSER, J. H. N88-18509
ROTHMAN, S. J. N88-17781
ROTHSCHILD, S. L. N88-17875
ROTUNNO, ARTHUR A. N88-17816
ROWE, JOSEPH N88-18175
ROY, S. N88-17747
RUBESIN, MORRIS W. N88-17587
RUCKMAN, M. W. N88-18479
RUDY, DAVID HENRY N88-17931
RYAN, JAMES W. N88-18409
RYLES, RICHARD RANDOLPH N88-17611
RYMZHANOV, K. S. N88-18164

S

SABATINI, R. L. N88-18475
N88-18477
SACCHILANDRIANI, GIOVANNI N88-18345
SACKS, R. N88-17977
SADLER, GERALD G. N88-17715
SADOWAY, D. R. N88-17906
SAKHAROVA, Z. F. N88-18128
N88-18158
SALATHE, R. P. N88-17982
SALERNO, R. F. N88-18006
SALIVON, S. G. N88-18147
SALTZMAN, BARRY N88-18091
SAMEH, A. N88-18274
N88-18288
SAMPIETRO, M. N88-17907
SAMPSON, G. W. N88-17873
SAMPSON, W. B. N88-18472
SANDERFER, DWIGHT T. N88-17596
SANDERS, J. A. N88-18336
SANTOS, JOSE LUIS TRIGO N88-18032
SARIBEKYAN, A. S. N88-18137
SARVAS, J. N88-18179
SATTERFIELD, D. E. N88-18199
SAUNDERS, R. D. N88-18401
SAVCHENKO, N. YA. N88-18140
SAVINA, V. P. N88-18134
SAYLOR, PAUL E. N88-18332
SCAPOLLA, TERENZIO N88-18041
SCHAPPERT, GOTTFRIED T. N88-17988
SCHARLEMANN, E. T. N88-18435
SCHERTZ, W. W. N88-18073
SCHLICKENMAIER, HERBERT N88-17616
SCHMALZER, PAUL A. N88-18148
SCHMATZ, MANFRED A. N88-17846
SCHMIDT, E. N88-17671
SCHNEBEL, EDGAR M. N88-17706
SCHNEDAR, CHRISTOPHER P. N88-18514
SCHNEIDER, HORST N88-17863
SCHNELL, R. N88-18079
SCHOENBACH, KARL H. N88-17900
SCHOENE, J. N88-17668
SCHONBERG, WILLIAM P. N88-18004
SCHRAMM, D. N. N88-18531
SCHRAMM, RICHARD E. N88-18111
SCHREIBER, R. N88-18247
SCHUBERT, JOHANNES N88-17832
SCHUBERT, W. K. N88-18461
SCHUCK, WOLF-DIETER N88-17862
SCHULLER, I. K. N88-18452
SCHWAERZLER, KARL N88-17822
SCHWARTZ, ALAN W. N88-17602
SCHWARZ, R. L. N88-18509
SCOTT, G. W. N88-18509
SCOTT, M. N88-18483
SCOTT, MARION L. N88-18405
SCRIBNER, D. A. N88-18399
SCRUBY, C. B. N88-18015
N88-18016
N88-18027
SEAGER, C. H. N88-18461
SEELER, HARTWIG N88-17851
SEIDEL, HELMUT N88-17838
SEKI, YASUSHI N88-18418
SENATORE, G. N88-17677
SERGEYEVSKY, ANDREY N88-18538
SETTLES, GARY S. N88-17957
SHAPAR, E. A. N88-18266
SHEALY, J. R. N88-18444
SHELDON, MARK A. N88-18273
SHELTON, R. N. N88-18476
SHEMDIN, OMAR H. N88-17872
SHEN, YU N88-17943
SHEPARD, R. L. N88-17911
SHEPHERD, C. M. N88-17753
N88-17777
SHIN, KANG G. N88-18230
SHIPOV, A. A. N88-18132
SHIRAZI, B. N88-18249
SHIVAKUMAR, K. N. N88-17737
SHMIDT, L. G. N88-18137
SHORE, B. W. N88-17977
SHREWSBURY, GEORGE D. N88-17591
SHULER, T. N88-17871
SHUVALOV, R. S. N88-17904
SHYNE, RICKEY J. N88-17686
SIEGEL, HOWARD JAY N88-18209
SIEGMUND, O. H. W. N88-17970
SILET, J. N88-17653
SIMAVONYAN, K. V. N88-18162
SIMON, MARVIN K. N88-17691
SIMON, R. L. N88-18063
SIMONETT, DAVID N88-18049
SIMONOV, L. G. N88-18137
SIMONS, RAINEE N. N88-17880
SINGHAL, MUKESH N88-18221
SINHA, N. N88-17588
SINKOVIC, B. N88-18479
SIRENKO, S. P. N88-18132
N88-18167
SIRLIN, A. N88-18494
SKIENA, STEVEN S. N88-18267
SKOGLUND, M. N88-18286
SLASKI, M. N88-18451
SLEPCHENKO, L. A. N88-18495
SLINEY, HAROLD E. N88-17796
SMAGA, J. A. N88-18064
SMALLWOOD, D. O. N88-18033
SMEDSKJAER, L. C. N88-18454
SMITH, ALAN JAY N88-18196
SMITH, E. J. N88-18548
SMITH, G. C. N88-17969
SMITH, HENRY I. N88-17923
SMITH, JOHN B. N88-18298
SMITH, R. D. N88-17759
SMITH, R. E. N88-17902
SMITH, TREVOR S. N88-17665
SMYTH, WILLIAM H. N88-18540
SOEFFKER, E. N88-17689
SOLOMON, J. A. N88-18510
SOLOVEV, V. O. N88-18492
SORENSEN, D. C. N88-18287
SOTNIKOV, G. V. N88-18457
SOVERS, O. J. N88-18523
SPADY, AMOS A., JR. N88-17616
SPAID, FRANK W. N88-17597
SPENCE, RODNEY L. N88-17899
SPOHNHOLTZ, CHERYL L. N88-18045
SPRANGLE, P. N88-17997
SREENATH, N. N88-18042
SRIDHARAN, N. S. N88-18239
STACEY, K. A. N88-18018
STACY, A. N88-18468
STADUKHIN, YE. B. N88-18142
STALLARD, B. N88-18430
STANIEK, S. N88-17896
STANLAND, C. F. N88-18264
STARKEN, H. N88-17680
STAUDHAMMER, JOHN N88-18233
STAVRAKAKIS, I. N88-18363
STEELE, D. N88-17684
STEGEMAN, G. I. N88-17892
STEIN, W. E. N88-17975
STEINERT, W. N88-17880
STEINFELD, A. N88-18077
STEINKE, R. G. N88-17953
STEINSIEK, F. N88-17689
STELLNER, K. L. N88-17783
STEPANOV, V. K. N88-18169
STEPNIEWSKI, W. Z. N88-17642
STEVENS, GRADY H. N88-17899

STEWART, J. N88-17778
STEWART, R. E. N88-17970
STEWART, W. E. N88-18081
STLUKA, EDWARD F. N88-17693
STOCKS, G. M. N88-18394
STOECKEL, KARL N88-17826
STOER, RAY N88-17636
STOLTE, H.-H. N88-17689
STONER, GLENN E. N88-17782
STOUGHTON, JOHN W. N88-18236
STRIZHANOVA, M. B. N88-18412
STRONGIN, G. L. N88-18136
STRONGIN, M. N88-18478
N88-18479
STROTTMAN, D. D. N88-17986
STRUEDER, L. N88-17907
STRUPPA, DANIELE C. N88-18355
STUHMILLER, JAMES H. N88-18184
STUNDER, B. N88-18079
STYLES, R. C. N88-18199
SU, RENJENG N88-18009
SUBRAHMANYAM, P. A. N88-18200
SUENAGA, M. N88-18475
N88-18477
SUGIHARA, MASAYOSHI N88-18416
SUGLA, BINAY N88-18201
SUKHORUKOV, S. T. N88-18426
SULLIVAN, R. F. N88-17813
SULLIVAN, THOMAS J. N88-17666
SULZMAN, F. M. N88-18125
SUPERIORE, SCUOLA N. N88-18355
SURGI, NAOMI N88-18103
SUTER, L. N88-18433
SUUBERG, E. N88-17760
SUZUKI, MOTOE N88-17771
SVERSHKOVA, V. S. N88-18160
SWANSON, ROBERT E. N88-17782
SWAYAMBUNATHAN, V. N88-18448
SWEET, W. L. N88-18290
SZODRUCH, JOACHIM N88-17848
SZYMANSKI, BOLESLAW K. N88-18222

T

TABBUTT, S. N88-18121
TACLA, A. N88-18529
TAFTO, J. N88-18475
TAJIMA, TOSHIKI N88-18419
TAKEFUJI, YOSHIYASU N88-18238
TALLERICO, P. J. N88-17908
TALMAN, A. J. J. N88-18281
TAM, D. W. N88-17895
TANG, C. M. N88-17997
TANG, CHII-JAU N88-17944
TANG, PEIYI N88-18311
N88-18313
TANG, WEI-PAI N88-18370
TAQQU, MURRAD S. N88-18371
TARG, RUSSELL N88-17626
TARLETON, LESLEY FRANCES N88-18088
TAYLOR, ANTOINETTE J. N88-17988
TAYLOR, E. W. N88-17878
TAYLOR, FRED J. N88-18196
TAYLOR, ROY A. N88-18004
TEETER, RONALD N88-18175
TEMME, LEONARD A. N88-18186
TESTARD-VAILLANT, FRANCOIS-XAVIER .. N88-18237
TEZAKI, ATSUMU N88-17769
THEARLING, KURT H. N88-18267
THEUNISSEN, ERNST N88-17827
THOMANEK, FRANZ-R. N88-17830
THOMAS, G. N88-18480
THOMAS, M. E. N88-18053
THOMPSON, C. P. N88-18326
THRESHER, R. W. N88-18070
TICHLER, JOYCE L. N88-18508
TIGRANYAN, R. A. N88-18172
TIJHUIS, A. G. N88-17887
TIKHONOV, V. V. N88-17904
TIKUNOV, B. A. N88-18161
TILL, L. E. N88-18505
TINKHAM, M. N88-17920
TISCHLER, MARC N88-18174
TISCHLER, MARK B. N88-17643
N88-17646
TITCHMARSH, J. M. N88-17753
TITI, E. S. N88-18118
TOMBOULIAN, SHERRYL N88-18279
N88-18299
TONE, TATSUZO N88-18417
TORR, DOUGLASS N88-18084
TOULOUSE, J. N88-18378
TOY, E. J. N88-18227
TRABIA, MOHAMED BAHAA EL-DEEN N88-18003
TRACZ, WILLIAM J. N88-18212
TRAVIS, C. C. N88-18173
TREBES, J. E. N88-17979
TRETICK, BRIAN N88-18303
TRIPPENSEE, GARY A. N88-17644
TROULLIER, N. N88-18488
N88-18491
TSAO, J. Y. N88-18470
TSATURYAN, A. K. N88-18137
TSENG, J. B. N88-17612
TSUCHIYA, KAZUO N88-17730
TSUKAMOTO, KATSUO N88-17704
TUCKER, M. D. N88-17903
TURBASOV, V. D. N88-18152
TURETSKAYA, A. S. N88-18136
TURGUT, ALTAN N88-18112
TURK, G. R. N88-18013
TURKO, B. T. N88-17888
N88-17889
TURNBULL, L. N88-17901
TURNER, D. B. N88-18104
TURRA, S. N88-17670
TUSON, A. T. N88-18026

U

UCKAN, T. N88-18436
UDDING, J. T. N88-18285
UDELL, K. S. N88-17927
UHM, H. S. N88-17898
USHAKOV, A. S. N88-18159
N88-18181
USHAKOV, I. B. N88-18168
USHAKOV, V. F. N88-18142

V

VALENT, PHILIP J. N88-18113
N88-18114
VANBLARICUM, T. J. N88-17735
VANDAM, H. N88-18502
VANDENBERG, P. M. N88-18337
N88-18338
VANDENHEUVEL, E. P. J. N88-18525
VANDENWOLLENBERG, A. L. N88-18187
VANDERWEIDEN, R. M. N88-17951
VANEMDEBOAS, P. N88-18280
VANHOVE, M. A. N88-18467
VANHOY, B. W. N88-17687
VANKA, S. P. N88-18326
VANPARADIJS, J. N88-18525
VANROOYEN, D. N88-17773
VANSCHILFGAARDE, MARK N88-18447
VANWACHEM, P. B. N88-18178
VASILYEVA, T. D. N88-18163
VATTER, I. A. N88-17753
VAVASIS, S. N88-18513
VEERASINGAM, R. N88-18442
VEERS, P. S. N88-18038
VEESER, L. R. N88-17971
VEIDENBAUM, A. V. N88-18308
VENTURINI, E. L. N88-18449
N88-18469
N88-18471
VERBUNT, F. N88-18525
VERDIECK, JAMES F. N88-17816
VERGHESE, GEORGE C. N88-18358
VETROVA, YE. G. N88-18170
VICROY, DAN D. N88-17619
VIEGAS, JOHN R. N88-17587
VIGIL, A. S. N88-17814
VIGNAU, H. N88-17653
VILLARREAL, RAMIRO N88-18331
VILVILYAMS, I. F. N88-18153
VINOKUR, M. N88-18344
VIRKAR, A. V. N88-17807
VLASOV, V. D. N88-18169
VLASOVA, T. F. N88-18134
VOGELSANG, M. E. N88-17794
VOITKOWJAK, M. N88-18153
VOLOSHIN, M. B. N88-18542
VONHOESSLE, WOLFGANG N88-17862
VONLUETZOW, H. B. N88-18099
VONTEIN, VOLKER N88-17853
VOROTNIKOVA, YE. V. N88-18144
VYSOTSKIJ, M. I. N88-18542

W

WADE, T. N88-17809
WADLEY, H. N. G. N88-18015
WAGGONER, EDGAR G. N88-17614
WAGNER, DOUGLAS A. N88-17667
WAHBA, GRACE N88-18106
WAHIDUZZAMAN, S. N88-17804
WAKEMAN, ABRAHAM N88-18240
WALKER, J. H. N88-18401
WALKER, JAMES D. N88-17958
WALL, A. N88-17768
N88-18487
N88-18488
N88-18490
N88-18491
WALLACE, C. S. N88-18232
WANG, K. N88-18480
WANG, T. N88-18475
WANG, Z. Y. N88-17950
WANNER, ELEONORE H. N88-18292
WANTROBA, A. S. N88-18073
WARD, R. C. N88-18173
WARDLAW, A. B., JR. N88-17924
WARNER, AMY N88-18507
WARREN, R. W. N88-17975
WATANABE, YASUO N88-17769
WEBER, H. P. N88-17982
N88-18403
WEILAND, CLAUS N88-17859
WEINER, J. H. N88-17805
WEISE, DANIEL W. N88-17918
WEISS, STEPHEN F. N88-18298
WEIZEL, W. N88-18462
WELCH, L. S. N88-17776
WENDT, HANS-JOACHIM N88-17836
WESTON, R. E., JR. N88-17991
WEYGAND, D. P. N88-18318
N88-18319
WHEELER, ROBERT L. N88-18353
WHELAN, D. A. N88-17979
WHINSTON, ANDREW N88-18209
WHITE, N. N88-18336
WHITTEN, G. Z. N88-18095
WICHURA, MICHAEL J. N88-18362
WICKS, G. W. N88-18444
WIENER, JOSEPH N88-18349
WIESMANN, H. N88-18478
WIESTER, M. J. N88-18149
WILCOX, WILLIAM R. N88-17784
WILEY, LOWELL F. N88-17722
N88-17723
N88-17724
WILKINS, DAVID C. N88-18323
WILLIAMS, D. E. N88-17778
WILLIAMS, FRANK L. N88-17716
N88-17717
WILLIAMS, J. M. N88-18482
WILLIAMSON, R. G. N88-17655
WILSON, ANDREW N88-17675
WILSON, W. E. N88-18385
WINANS, R. E. N88-17750
WINDOM, H. L. N88-18108
WINKLER, PETER J. N88-17839
WINTER, H. H. N88-17797
WISE, DAVID S. N88-18251
WIT, J. M. N88-18187
WITTBERG, T. N. N88-18006
WITTIE, LARRY D. N88-18215
WITTIG, C. N88-17764
WITTLE, MARK E. N88-18245
WOCKE, HANS N88-17824
WOHLEVER, C. N88-18376
WOJTOWICZ, M. N88-17760
WOLFRAM, STEPHEN N88-18267
WOLPERT, LAWRENCE N88-18188
WONG, J. N88-18472
WONG, KOON N. N88-17815
WOOD, N. J. N88-17594
WOOD, NORMAN J. N88-17596
WOOD, RICHARD M. N88-17615
WOODARD, D. W. N88-18444
WOODS, CLAUDIA M. N88-17954
WRIGHT, B. W. N88-17759
WRIGHT, KENNETH HERBERT, JR. N88-18427
WYLIE, DONALD P. N88-18105

Y

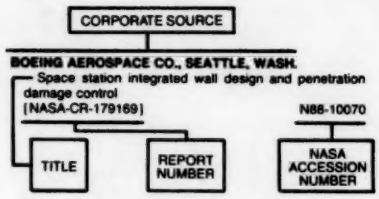
YAFET, Y. N88-18465
YAMADA, KATSUHIKO N88-17730
YAMAGUCHI, ISAO N88-17730
YAMAMOTO, TAKAKAZU N88-17803
YAMAMOTO, TOKUO N88-18112
YANG, H. D. N88-18476
YANG, R. N88-18011
YARULLIN, KH. KH. N88-18163
YASTREBOV, V. YE. N88-18133
YATES, THOMAS C. N88-17665
YE, YINYU N88-18277
YEE, H. C. N88-18343
N88-18344
YEN, YIN-CHAO N88-17925

YEW, PEN-CHUNG N88-18311
N88-18313
N88-18314
YODER, G. L., JR. N88-17818
YOLKEN, H. THOMAS N88-18020
YORK, B. J. N88-17588
YOU, HOYDOO N88-18484
YOUNG, E. W. A. N88-17776
YOUNG, J. F. N88-17996
YOUNG, LUKE T. N88-18267
YU, C. T. N88-18219
YU, FAN-MING N88-17932
YU, JAEJUN N88-18453
YU, LI-HUA N88-17990
YU, S. S. N88-18435
YUAN, S. W. K. N88-17720
YUH, C. Y. N88-18058
YUNG, CHAIN NAN N88-17582
YUSHKEVICH, YU. V. N88-18415

Z

ZAAR, J. N88-17703
ZABKA, WERNER N88-17849
ZAFF, BRIAN F. N88-18188
ZAKAZNOV, A. V. N88-18129
ZANDBERGEN, H. W. N88-18468
N88-18480
ZARETSKY, ERWIN V. N88-18007
ZARITSKIY, V. V. N88-18131
ZAVADOVSKIY, A. F. N88-18152
ZEZEROV, A. YE. N88-18159
ZHIDKOV, V. V. N88-18124
N88-18126
N88-18138
ZHOGOLEV, V. E. N88-18412
ZHU, CHUAN-QI N88-18311
N88-18313
ZIELINSKI, ALEX N88-17913
ZILFYAN, A. V. N88-18166
ZIMMERMAN, R. S. N88-17743
ZIMMERMANN, HELMUT N88-17850
ZUBKOVA, I. V. N88-18145
ZUE, VICTOR W. N88-17893
ZWAENEPOEL, WILLY N88-18217
ZWEIFEL, P. F. N88-18369
ZYSSET, B. N88-18403

Typical Corporate Source Index Listing



Listings in this index are arranged alphabetically by corporate source. The title of the document provides the user with a brief description of the subject matter. The report number helps to indicate the type of document cited (e.g., NASA report, translation, NASA contractor report). The NASA accession number denotes the number by which the citation is identified. The titles are arranged under each corporate source in ascending accession number order.

A

ADMIRALTY RESEARCH ESTABLISHMENT, POOLE (ENGLAND).
The effect on initial bond strength and durability of a Phosphoric Acid Dip (PAD) following chromic acid anodising of aluminum
[ARE-TM(UMM)-87402] N88-17772

ADVANCED DECISION SYSTEMS, MOUNTAIN VIEW, CALIF.
A strategy for failure prediction N88-18243

ADVISORY GROUP FOR AEROSPACE RESEARCH AND DEVELOPMENT, NEUILLY-SUR-SEINE (FRANCE).
Advanced Technology for Aero Gas Turbine Components
[AGARD-CP-421] N88-17647
Effectiveness of various control surfaces in quasi-steady and unsteady conditions
[AGARD-R-735] N88-17682

AERITALIA S.P.A., TURIN (ITALY).
Study on long term evolution towards European manned space flight. Volume 1: Executive summary
[MBB-RAS-004/87-VOL-1] N88-17689

AEROJET TECHSYSTEMS CO., SACRAMENTO, CALIF.
Arcjet thruster research and technology
[NASA-CR-180865] N88-17732

AERONAUTICAL RESEARCH LABS., MELBOURNE (AUSTRALIA).
Effect of post-cure heat-treatment on static and fatigue behaviour of XAS-914C carbon fibre composite
[AD-A186943] N88-17735
Operators manual for a computer controlled impedance measurement system
[AD-A187513] N88-17917
Applications of energy density theory in cyclic plasticity
[AD-A186947] N88-18023
Computed stress and strain distributions under interference fit and after coldworking
[AD-A1[illegible]950] N88-18024

AEROSPACE MEDICAL RESEARCH LABS., WRIGHT-PATTERSON AFB, OHIO.
Supersonic and subsonic aircraft noise effects on animals: A literature survey
[AD-A186922] N88-18373

AIR FORCE INST. OF TECH., WRIGHT-PATTERSON AFB, OHIO.
Wind tunnel studies of circulation control elliptical airfoils N88-17598
The soft/hard wet anodization of aluminum oxide and its use in a thin film multilayered capacitor
[AD-A187575] N88-17919
Development of a graphics based two-attribute utility assessment program with application to mission planning
[AD-A187276] N88-18292
The effects of data structure on total time on test plots
[AD-A187628] N88-18296

AIR FORCE SYSTEMS COMMAND, WRIGHT-PATTERSON AFB, OHIO.
An evaluation of effectiveness of PTFE (polytetrafluoroethylene) type friction reducers on reducing friction and wear
[AD-A187440] N88-18010

AIR FORCE WRIGHT AERONAUTICAL LABS., WRIGHT-PATTERSON AFB, OHIO.
The coming revolution in turbine engine technology N88-17648

ALABAMA UNIV., HUNTSVILLE.
Shuttle rocket booster computational fluid dynamics
[NASA-CR-182518] N88-17733
A study of single and binary ion plasma expansion into laboratory-generated plasma wakes
[NASA-CR-4125] N88-18427

ALASKA UNIV., FAIRBANKS.
A study of the magnetic field annihilation process in the magnetosphere and some geotechnical applications
[DE88-004165] N88-18096

ALLIED BENDIX CORP., KANSAS CITY, MO.
Ion chromatography in the manufacture of multilayer circuit boards
[DE88-002428] N88-17902

ALUMINUM CO. OF AMERICA, CORONA, CALIF.
Durability and damage tolerance of aluminum castings
[AD-A186444] N88-18013

AMERICAN INST. OF AERONAUTICS AND ASTRONAUTICS, NEW YORK, N.Y.
GAS 450: A space payload for the People Central Coast Student Experimenters N88-17709

AMES LAB., IOWA.
Superconductivity and phase stability in the heavy rare earth quaternary compounds RBa2Cu3O7 (R = Ho, Er, Tm, Yb, Lu)
[DE88-003478] N88-18476

AMSTERDAM UNIV. (NETHERLANDS).
Machine models and simulations
[PB88-118690] N88-18260

ANALYTICAL METHODS, INC., REDMOND, WASH.
Wall jet analysis for circulation control aerodynamics. Part 2: Zonal modeling concepts for wall jet/potential flow coupling N88-17593

ARGONNE NATIONAL LAB., ILL.
Application of inverse gas chromatography to fluidity studies
[DE88-002896] N88-17750
Gas phase pulse radiolysis
[DE88-002981] N88-17751
Materials development for JPL oxygen plant
[DE88-003067] N88-17752
Insights into the mechanisms of chemical reactions: Reaction paths for chemical reactions
[DE88-003041] N88-17755
Effect of low-temperature aging on the mechanical properties of cast stainless steels
[DE88-002872] N88-17774
Diffusion studies in amorphous NiZr alloys
[DE88-003009] N88-17781
Models for ionic transport in glass
[DE88-002880] N88-17799
NMR (Nuclear Magnetic Resonance) imaging for detecting binder/plasticizers in green-state structural ceramics
[DE88-003111] N88-17800
The chemistry of the hypochlorite neutralization of hydrazine fuels
[DE88-002971] N88-17812
Mechanistic model for void distribution in flashing flow
[DE88-002948] N88-17928
A review of flow-induced vibration in two-phase flow
[DE88-002873] N88-17946
One-dimensional leakage-flow vibration instabilities
[DE88-002875] N88-17947
Analysis and application of the constant tensile load test for polyethylene gas pipe materials
[DE88-002868] N88-18037
Laboratory evaluation and analysis of advanced lead-acid load-leveling batteries
[DE88-002851] N88-18084
Side-by-side comparisons of evacuated compound parabolic concentrator and flat plate solar collector systems at temperatures of 90 to 100°C
[DE88-004717] N88-18073
Programming methodology and performance issues for advanced computer architectures
[DE88-003098] N88-18287
Application of a multigrid method to a buoyancy-induced flow problem
[DE88-003961] N88-18326
A multigrid preconditioner applied to a two-dimensional convection-diffusion problem
[DE88-004765] N88-18329
Spin disorder resistivity and bare Curie temperature in the ferromagnetic superconductor ErRh4B4
[DE88-003016] N88-18445
Electron transfer to iron(3) oxide colloids
[DE88-002885] N88-18448
Normal and superconducting state properties of La2-xSr/sub x/CuO4
[DE88-003013] N88-18450
Superconducting and magnetic properties of Fe-doped oxide superconductors
[DE88-003024] N88-18451
The physics of metallic superlattices: An experimental point of view
[DE88-003080] N88-18452
Electronic structure, charge transfer excitations and high temperature superconductivity
[DE88-003096] N88-18453
Positron-annihilation 2D-ACAR studies of disordered and defected alloys
[DE88-003118] N88-18454
High-resolution X-ray microstructural study of single crystals of YBa2Cu3O/sub 7-y/
[DE88-004856] N88-18484

ARIZONA STATE UNIV., TEMPE.
Optimal design and parameter identification of flexible rotor-bearing systems N88-18002
Design conditions and workspace for the generally-proportioned 3-hinge spherical wrist for robots N88-18003

ARIZONA UNIV., TUCSON.
Guided-wave approaches to spectrally selective energy absorption
[NASA-CR-182532] N88-17892
Signal processing studies program optical signal amplification, volume 2
[AD-A188054] N88-17896
Signal processing studies program optical signal amplification, volume 1
[AD-A188055] N88-17897
Chemical activation of molecules by metals: Experimental studies of electron distributions and bonding
[DE88-004465] N88-18393

ARMY COLD REGIONS RESEARCH AND ENGINEERING LAB., HANOVER, N.H.
Approximate solutions of heat conduction in a medium with variable properties
[AD-A186933] N88-17925
Physical and structural characteristics of Weddell Sea pack ice
[AD-A188189] N88-18119

ARMY COMBAT SYSTEMS TEST ACTIVITY (PROVISIONAL), ABERDEEN PROVING GROUND, MD.
Corrosion and deterioration testing in humid tropic environments
[AD-A186917] N88-17783

ARMY ENGINEER TOPOGRAPHIC LABS., FORT BELVOIR, VA.
Autocorrelation of control points on 11-band multispectral imagery
[AD-A188185] N88-18058

Estimation of gravity vector components from Bell gravity gradiometer and auxiliary data under consideration of topography and associated analytical upward continuation aspects
[AD-A188146] N88-18099

ARMY RESEARCH OFFICE, RESEARCH TRIANGLE PARK, N. C.
Future directions in computer architecture and software workshop N88-18258

ARMY STATEGIC DEFENSE COMMAND, HUNTSVILLE, ALA.
Signal and data processing for IR sensors N88-18199

ATMOSPHERIC AND ENVIRONMENTAL RESEARCH, INC., CAMBRIDGE, MASS.
Extended atmospheres of outer planet satellites and comets
[NASA-CR-181449] N88-18540

ATOMIC ENERGY RESEARCH ESTABLISHMENT, HARWELL (ENGLAND).
Fabrication and materials evaluation of high performance aligned ceramic fibre reinforced glass matrix composite
[AERE-R-12517] N88-17736
The measurement of chemical compositon with high spatial resolution using a dedicated scanning transmission electron microscope
[AERE-R-12317] N88-17753
High resolution electron and ion microscopy
[AERE-R-12502] N88-17754
The influence of the heating procedure on the oxidation behaviour of NiAl studied by XPS
[AERE-R-12498] N88-17776
A detailed microstructural examination of the cause of HAZ cracking in type 316 steel
[AERE-R-12428] N88-17777
Studies of the initiation of pitting corrosion on stainless steels
[AERE-M-3615] N88-17778
Beneficial and detrimental effects of silica in the high temperature oxidation of 20Cr/25Ni/Nb stainless steel
[AERE-R-12667] N88-17779
Bias, internal stress and substrate effects on the microstructure and properties of PVD-wear resistant coatings
[AERE-R-12360] N88-17798
The development of emission tomography for the nuclear industry
[AERE-R-12319] N88-18014
Acoustic emission-microstructural relations in ferritic steels. Part 3: The effect of inclusion content
[AERE-R-12041] N88-18015
Acoustic emission measurements of PWR weld materials with inserted defects
[AERE-R-12386] N88-18016
The measurement of stress in steels of varying microstructure by Barkhausen and magneto-acoustic emission
[AERE-R-12387] N88-18027

AUBURN UNIV., ALA.
Design for a TPL compiler system: A system for retargeting high level language programs N88-18248

B

BALLISTIC RESEARCH LABS., ABERDEEN PROVING GROUND, MD.
An infra-red investigation of HAN (Hydroxylammonium Nitrate)-based liquid propellants
[AD-A187226] N88-17815
Pulsed current transformer for low inductive loads
[AD-A187224] N88-17913

BATTELLE COLUMBUS LABS., RESEARCH TRIANGLE PARK, N.C.
Droplet formation for liquid monopropellant jets
[AD-A187172] N88-17956

BATTELLE COLUMBUS LABS., OHIO.
Navigation recovery block design description
[NASA-CR-182473] N88-18022
Proceedings of the Workshop on Future Directions in Computer Architecture and Software
[AD-A184949] N88-18191

BATTELLE INST., FRANKFURT AM MAIN (WEST GERMANY).
Study on long term evolution towards European manned space flight. Volume 1: Executive summary
[MBB-RA3-004/87-VOL-1] N88-17689

BATTELLE PACIFIC NORTHWEST LABS., RICHLAND, WASH.
Supercritical fluid extraction-gas chromatography of Volatile Organic Compounds (VOC) from tenax devices
[PB88-124300] N88-17759

BDM CORP., MCLEAN, VA.
Hardware implementation for special functions. An application for combat simulation N88-18197

BELL TELEPHONE LABS., INC., HOLMDEL, N. J.
On parallelism in software/hardware design tools N88-18200
Role of broadcasting in multiprocessor systems N88-18201

BELL TELEPHONE LABS., INC., MURRAY HILL, N. J.
Magnetic rare earth superlattices
[DE88-003483] N88-18465
The electronic structure of YBa2Cu3O/sub 7-delta/ above and below T/sub c/
[DE88-003495] N88-18479

BENDIX FIELD ENGINEERING CORP., COLUMBIA, MD.
Theoretical and observational problems with Holes in the far UV dayglow
[AD-A188190] N88-18100

BERN UNIV. (SWITZERLAND).
Laser pulse width dependent surface ripples on silicon
[PB88-127311] N88-17982
The 80 fsec soliton-like pulses from an optical-nonlinear fiber resonator
[PB88-127303] N88-18403

BOEING AEROSPACE CO., SEATTLE, WASH.
Space station integrated wall damage and penetration damage control. Task 5: Space debris measurement, mapping and characterization system
[NASA-CR-179281] N88-17688
System analysis study of space platform and station accommodations for life sciences research facilities. Volume 1: Executive summary. Phase A: Conceptual design and programmatics
[NASA-CR-179268] N88-17721
System analysis study of space platform and station accommodations for life sciences research facilities. Volume 2: Study results, attachment 2. Phase A: Conceptual design and programmatics
[NASA-CR-179272] N88-17722
System analysis study of space platform and station accommodations for life sciences research facilities. Volume 2: Study results. Appendix E: Work breakdown structure and dictionary
[NASA-CR-179274] N88-17723
System analysis study of space platform and station accommodations for life sciences research facilities. Volume 2: Study results. Appendix D: Life sciences research facility requirements
[NASA-CR-179273] N88-17724
Spin disorder resistivity and bare Curie temperature in the ferromagnetic superconductor ErRh4B4
[DE88-003016] N88-18445

BOEING CO., SEATTLE, WASH.
Windshear training aid. Volume 1: Overview, pilot guide, training program
[PB88-127196] N88-17637

BOEING COMMERCIAL AIRPLANE CO., SEATTLE, WASH.
Crew interface with windshear systems N88-17631

BOELKOW-ENTWICKLINGEN K.G., STUTTGART (WEST GERMANY).
Boundary layer calculation using digital computers
[REPT-MM-4] N88-17821
Dependence of the expectancy of hitting on the number of spread shots. Determination of the expectancy of hitting using a spread salvo
[REPT-FM6] N88-17829
Investigation of several spread shot conditions
[REPT-TR-164] N88-17830
Determination of the drag of missiles with variable lateral acceleration possibility
[REPT-FM15] N88-17831

BOLKOW ENTWICKLUNGEN K. G., MUNICH (WEST GERMANY).
Rocket and airjet propulsion for ballistic and aerodynamic space probes
[REPT-TR-527] N88-17826
Calculation and design of a ramjet missile
[REPT-TR-500] N88-17832

BOLT, BERANEK, AND NEWMAN, INC., CAMBRIDGE, MASS.
Semi-applicative programming N88-18239

BOSTON UNIV., MASS.
The origin of the diffuse X-ray background and the formation of galaxies and voids N88-18527

BRADLEY UNIV., PEORIA, ILL.
Developing a standard taxonomy or software engineering standards N88-18234

BRITISH AEROSPACE DYNAMICS GROUP, STEVENAGE (ENGLAND).
Study on long term evolution towards European manned space flight. Volume 1: Executive summary
[MBB-RA3-004/87-VOL-1] N88-17689

BRITISH BROADCASTING CORP., KINGSWOOD (ENGLAND).
Designing variable-length codes with good error-recovery properties
[BBC-RD-1987/19] N88-17876
The relationship between vision carrier-to-noise ratio and picture signal-to-noise ratio in a System I television receiver
[BBC-RD-1987/23] N88-17877
The assessment of the sound insulation requirements for a large broadcasting studio, using a scale model: Practical details
[BBC-RD-1987/21] N88-17878

BROOKHAVEN NATIONAL LAB., UPTON, N. Y.
Mechanisms of intergranular attack and stress corrosion cracking of alloy 600 by high-temperature caustic solutions containing impurities
[DE87-012820] N88-17773
A review of pitting corrosion in high temperature aqueous solutions
[DE88-003547] N88-17787
Thermogravimetric analysis of polymeric materials for an intermediate temperature solid electrolyte
[DE88-004854] N88-17809
Design of a charge sensitive preamplifier on high resistivity silicon
[DE88-003491] N88-17907
Capacitive charge division in centroid finding cathode readouts in MWPCs
[DE88-003545] N88-17969
Betatron oscillations in a free electron laser
[DE88-004859] N88-17990
Energy transfer studies with lasers
[DE88-004864] N88-17991
The implementation of artificial intelligence in control systems
[DE88-003497] N88-18318
The representation of knowledge within model-based control systems
[DE88-004863] N88-18319
Magnetic rare earth superlattices
[DE88-003483] N88-18465
The effect of magnetic impurities and barriers on the magnetization and critical current of fine filament NbTi composites
[DE88-004443] N88-18472
Grain boundaries, planar defects and superconducting properties of YBa2Cu3O7
[DE88-003477] N88-18475
Superconductivity and phase stability in the heavy rare earth quaternary compounds RBa2Cu3O7 (R = Ho, Er, Tm, Yb, Lu)
[DE88-003478] N88-18476
Superconducting properties and structural characterization of high T/sub c/ oxides
[DE88-003479] N88-18477
Penetration depth measurements of YBa2Cu3O/sub 7-delta/ at 4 MHz
[DE88-003493] N88-18478
The electronic structure of YBa2Cu3O/sub 7-delta/ above and below T/sub c/
[DE88-003495] N88-18479
High-resolution X-ray microstructural study of single crystals of YBa2Cu3O/sub 7-y/
[DE88-004856] N88-18484
Using SIR (Scientific Information Retrival) system for data management during a field program
[DE88-001555] N88-18508
Supernova mechanisms: Before and after SN1987a
[DE88-003489] N88-18533

BROWN UNIV., PROVIDENCE, R. I.
Low temperature reactivity of chars towards oxygen, appendix E2
[DE88-004088] N88-17760
Basic research on macromolecular dynamics
[PB88-141643] N88-17805

BULGARIAN ACADEMY OF SCIENCE, SOFIA.
Explicit solutions of moment problems, 1
[AD-A186018] N88-18325

C

CALIFORNIA INST. OF TECH., PASADENA.
Numerical studies of propagation of Lg waves across ocean continent boundaries using the Representation Theorem (RT) N88-18085
Emerging supercomputer architectures
[DE88-003539] N88-18262
Features of a TeraFlop supercomputer
[DE88-003540] N88-18263
Microscopic modeling of sound waves in granular material
[DE88-000348] N88-18375
The relation of solar wind structure to hydromagnetic discontinuities
[DE88-004304] N88-18548

CALIFORNIA STATE POLYTECHNIC COLL., SAN LUIS OBISPO.
A reliable data collection/control system N88-17708

CALIFORNIA STATE UNIV., FULLERTON.
Correlated processes in atomic collisions
[DE88-003508] N88-18383
CALIFORNIA STATE UNIV., SACRAMENTO.
Mechanisms of intergranular attack and stress corrosion cracking of alloy 600 by high-temperature caustic solutions containing impurities
[DE87-012820] N88-17773
CALIFORNIA UNIV., BERKELEY.
Boundary integral analysis of flow and deformation of long bubbles in capillaries
[DE88-002110] N88-17927
Performance of a photon counting microchannel plate intensifier with wedge and strip image readout
[DE88-003831] N88-17970
Research and development trends for memory hierarchies N88-18196
Plasma confinement calculations for TIBER-2
[DE88-004044] N88-18425
Plasma theory and simulation
[DE88-003620] N88-18437
Exponential lower bounds for finding Brouwer fixed points
[DE88-002864] N88-18513
Cosmic strings: A problem or a solution
[DE88-003410] N88-18535
CALIFORNIA UNIV., BERKELEY. LAWRENCE BERKELEY LAB.
Signal processing for an optical wide band data transmission system
[DE88-003854] N88-17888
Wide band data transmission system using optical fibers
[DE88-004555] N88-17889
Low-noise cryogenically cooled broad-band microwave preamplifiers
[DE88-004561] N88-17912
The use of optical fibers for shock pressure and timing measurements at high pressures
[DE88-004012] N88-17971
The role of analytical chemistry in assessing atmospheric effects of combustion
[DE88-003909] N88-18082
Spectroscopic studies of energy transfer in photosynthetic reaction centers of higher plants
[DE88-003850] N88-18121
Solving complex and disordered surface structures with electron diffraction
[DE88-003863] N88-18467
The structure and properties of twin boundaries in superconducting YBa2Cu3O7
[DE88-003864] N88-18468
Simulation and processing of high resolution images of defects and interfaces in superconducting YBa2Cu3O7
[DE88-003856] N88-18480
Grazing incidence X-ray scattering study of defect structures in MBE GaAs/Si using synchrotron radiation
[DE88-004556] N88-18483
Utilization of the JANAF (Joint Army Navy Air Force) database for chemical thermodynamic calculations
[DE88-004571] N88-18501
CALIFORNIA UNIV., LOS ANGELES.
Universal power spectra for wave turbulence: Applications to wind waves, flicker noise, solar wind spectrum and classical second sound N88-17879
Investigations of stimulated Raman scattering from high density underdense plasmas irradiated by a 0.35 micron laser N88-18421
CALIFORNIA UNIV., SANTA BARBARA.
Improved canopy reflectance modeling and scene inference through improved understanding of scene pattern
[NASA-CR-182486] N88-18049
CALSPAN ADVANCED TECHNOLOGY CENTER, BUFFALO, N.Y.
Operation of gas turbine engines in dust-laden environments N88-17654
CARNEGIE-MELLON UNIV., PITTSBURGH, PA.
Some further observations about reduced instruction set computers N88-18192
Software support for heterogeneous machines N88-18224
Future directions in computer architecture N88-18257
A method for assessing the software engineering capability of contractors: Preliminary version
[AD-A187230] N88-18290
Factors causing unexpected variations in Ada benchmarks
[AD-A187231] N88-18291
CASE WESTERN RESERVE UNIV., CLEVELAND, OHIO.
The use of multigrid techniques in the solution of the Elrod algorithm for a dynamically loaded journal bearing
[NASA-CR-180873] N88-17954
Theoretical analysis of adhesive fracture and crack-damage interactions N88-18030
Parallelism at the microlevel: Cooperative microcontrollers with real time considerations N88-18246
CENTRE NATIONAL DE LA RECHERCHE SCIENTIFIQUE, MARSEILLES (FRANCE).
Method for predicting performance limits of centrifugal compressors N88-17677
CHEVRON RESEARCH CO., RICHMOND, CALIF.
High-density jet fuels from coal syncrudes, appendix 4
[DE88-003132] N88-17813
CHICAGO UNIV., ILL.
Instrumentation and quantitative methods of evaluation
[DE87-013639] N88-18017
Ice-shelf response to ice-stream discharge fluctuation. Part 1: Unconfined ice tongues
[AD-A188147] N88-18117
On the barotropic model of the ocean circulation
[AD-A188148] N88-18118
The convergence rate for the strong law of large numbers: General lattice distributions
[AD-A187560] N88-18362
Studies in finite time thermodynamics
[DE88-004531] N88-18500
A look at Supernova 1987A
[DE88-003411] N88-18531
Cosmic strings: A problem or a solution
[DE88-003410] N88-18535
CINCINNATI UNIV., OHIO.
Implicit solution of the incompressible Navier-Stokes equations in primitive variables on non-staggered grids N88-17930
CITY COLL. OF THE CITY UNIV. OF NEW YORK.
Drosophila geotaxis as a tool for the study of aging N88-17706
CITY UNIV. OF NEW YORK, N.Y.
Subpicosecond optical digital computation using phase conjugate parametric generators
[AD-A188279] N88-18411
CIVIL ENGINEERING SQUADRON, SHEPPARD AFB, TEX.
Air Force geographic information and analysis system
[DE88-001420] N88-18505
CLARKSON UNIV., POTSDAM, N.Y.
Influence of convection on microstructure
[NASA-CR-182489] N88-17784
CLEMSON UNIV., S.C.
Performance evaluation of a loop interconnection structure N88-18229
SAGE: The Clemson University Systolic Array Generating Engine N88-18235
COHERENT TECHNOLOGIES, INC., BOULDER, COLO.
Airborne Doppler lidar detection of wind shear. Results of performance analysis N88-17627
COLORADO SCHOOL OF MINES, GOLDEN.
The role of composition and microstructure gradients on weld metal properties and behavior
[DE88-004956] N88-17791
COLORADO STATE UNIV., FORT COLLINS.
SISAL: Initial MIMD performance results N88-18208
COLORADO UNIV., BOULDER.
Robust controller design for flexible structures
[AD-A187217] N88-18009
Meteorological and aerosol measurements from the NOAA WP-3D aircraft during WATOX-86, January 4-9, 1986
[PB88-120860] N88-18079
Persistence characteristics of 500 mb blocking and zonal flows in the mid-latitudes of the Northern and Southern Hemispheres N88-18088
CONCORDIA UNIV., MONTREAL (QUEBEC).
Implementation of a buddy failure recovery concept in the NOVAC system N88-18205
CORNELL UNIV., ITHACA, N.Y.
A dynamical system/coherent structure approach to the fully developed turbulent wall layer N88-17578
A large strain thermomechanical forming model for elastic-viscoplastic behavior in metals N88-17780
The migration of grain boundaries in ceramic materials with particular reference to the sintering process
[DE88-004085] N88-17808
Piezoelectric laminates for torsional and bending model control: Theory and experiment N88-18029
Annotated computer output for split plot design: GENSTAT ANOVA
[AD-A187120] N88-18271
Microwave semiconductor research-materials, devices and circuits
[AD-A187121] N88-18444
CRANFIELD INST. OF TECH., BEDFORD (ENGLAND).
Cardiovascular and subjective measures of task demand in a low workload monitoring task
[REPT-8804] N88-18176

D

DAYTON UNIV., OHIO.
Characterization of the arc/spark excitation sources used in the spectrometric oil analysis program
[AD-A187131] N88-17758
DELAWARE UNIV., NEWARK.
Conjugate gradient spectral iterative technique
[PB88-126917] N88-18337
DELCO SYSTEMS OPERATIONS, MILWAUKEE, WIS.
Forward looking wind shear detection N88-17629
DEPARTMENT OF ENERGY, MORGANTOWN, W. VA.
Gas hydrate model development and validation
[DE88-001004] N88-17762
DEPARTMENT OF ENERGY, PORTLAND, OREG.
Cape Blanco wind farm feasibility study
[DE88-003748] N88-18059
Cape Blanco wind farm feasibility study
[DE88-003749] N88-18060
DEPARTMENT OF ENERGY, WASHINGTON, D. C.
Hydrogen Energy Coordinating Committee: Summary of DOE hydrogen programs for FY 1987
[DE88-003960] N88-17811
The role of repowering in America's power generation future
[DOE/FE-0096] N88-18076
DEUTSCHE AIRBUS G.M.B.H., MUNICH (WEST GERMANY).
The European Airbus A-300 N88-17824
DEUTSCHE FORSCHUNGS- UND VERSUCHSANSTALT FUER LUFT- UND RAUMFAHRT, BRUNSWICK (WEST GERMANY).
Numerical methods for propeller aerodynamics and acoustics at DFVLR N88-17688
DEUTSCHE FORSCHUNGS- UND VERSUCHSANSTALT FUER LUFT- UND RAUMFAHRT, COLOGNE (WEST GERMANY).
Secondary flow measurements with L2F-technique in centrifugal compressors N88-17676
Experimental investigation of a supercritical compressor rotor blade section N88-17680
Ten past and ten future GAS/MAUS-payloads N88-17696
DORNIER-WERKE G.M.B.H., FRIEDRICHSHAFEN (WEST GERMANY).
Study on long term evolution towards European manned space flight. Volume 1: Executive summary
[MBB-RA3-004/87-VOL-1] N88-17689
DU PONT DE NEMOURS (E. I.) AND CO., AIKEN, S.C.
Irradiation effects in metals
[DE88-004272] N88-17789
Personal computers and All-In-1: Document transfer and translation
[DE88-003760] N88-18264

E

ECOLE CENTRALE DE LYON (FRANCE).
Numerical simulation of diffuser/combustor dome interaction N88-17663
Parametric study of choke flutter with a linear theory N88-17673
ECOLE NORMALE SUPERIEURE, SAINT CLOUD (FRANCE).
Portable (and disposable) interpreters N88-18237
ELECTRIC POWER RESEARCH INST., PALO ALTO, CALIF.
Mechanisms of intergranular attack and stress corrosion cracking of alloy 600 by high-temperature caustic solutions containing impurities
[DE87-012820] N88-17773
ENERGY RESEARCH CORP., DANBURY, CONN.
Determination of optimum electrolyte composition for molten carbonate fuel cells literature review
[DE88-001015] N88-18058
ENTWICKLUNGSRING SUD, MUNICH (WEST GERMANY).
Development of vertical takeoff aircraft with turbojet engines in Germany N88-17822
Variable sweep wings N88-17823
ENVIRONMENTAL PROTECTION AGENCY, RESEARCH TRIANGLE PARK, N.C.
Developments in National Weather Service meteorological data collection programs as related to EPA (Environmetal Protection Agency) air pollution models
[PB88-130240] N88-18104
ENVIRONMENTAL RESEARCH INST. OF MICHIGAN, ANN ARBOR.
Radar backscatter from airports and surrounding areas N88-17623
ESSEX CORP., ALEXANDRIA, VA.
Helicopter external vision requirements and visual display characteristics: A report/bibliography, revision A
[AD-A187075] N88-17641

F

FANSTEEL WELLMAN DYNAMICS, CRESTON, IOWA.
Durability and damage tolerance of aluminum castings
[AD-A186444] N88-18013
FAYETTE MFG. CORP., TRACY, CALIF.
Wake effects in a Fayette 95-IIS wind turbine array
[DE88-001103] N88-18063
FEDERAL AVIATION ADMINISTRATION, SEATTLE, WASH.
Airworthiness considerations N88-17636
FEDERAL AVIATION ADMINISTRATION, WASHINGTON, D.C.
Lightsats and their attraction to budget oriented Federal agencies N88-17711
FEDERAL AVIATION AGENCY, ATLANTIC CITY, N.J.
Navigation recovery block design description
[NASA-CR-182473] N88-18022
FERMI NATIONAL ACCELERATOR LAB., BATAVIA, ILL.
Zero temperature quark matter equation of state
[DE88-003408] N88-18496
A look at Supernova 1987A
[DE88-003411] N88-18531
Hadron-quark phase transition in dense stars
[DE88-003412] N88-18532
Quark matter in astrophysics and cosmology
[DE88-003406] N88-18534
Cosmic strings: A problem or a solution
[DE88-003410] N88-18535
FIAT AVIAZIONE S.P.A., TURIN (ITALY).
Analysis of possible transmission arrangements applicable for driving single or twin counterrotating fans on propfan engines N88-17670
FLORIDA STATE UNIV., GAINESVILLE.
The structure and dynamics of monsoon depressions N88-18102
Systematic errors of the FSU global spectral model N88-18103
FLORIDA UNIV., GAINESVILLE.
The design of ultra high-speed numeric intensive systems (having fault tolerant and load balancing capabilities) N88-18196
Directions in computer graphics architecture N88-18233
Straightening and the Stanley decomposition for the (2;n)-nilpotent vectorfield
[PB88-126685] N88-18336
FOERSVARETS FORSKINGSANSTALT, STOCKHOLM (SWEDEN).
Effects of aviation fluids on carbon fibre composite material
[PB88-127857] N88-17740
Effect of thermal shock on carbon fiber/epoxy composites
[PB88-128228] N88-17741
Results from the melting of tungsten composites under microgravity (Texus 10 flight)
[PB88-128236] N88-17817
MTI-Interface (Moving Target Indication-Interface) for simple radar
[PB88-126578] N88-17884
Implementation of encoders and decoders for Reed-Solomon codes
[PB88-126628] N88-18286
FUJITSU LTD., ATSUGI (JAPAN).
Protein-crystal growth experiment (planned) N88-17700

G

GENERAL DYNAMICS CORP., SAN DIEGO, CALIF.
Archetyping: A knowledge-based reuse paradigm N88-18214
GENERAL ELECTRIC CO., CINCINNATI, OHIO.
Aerodynamic performance of a scale-model, counter-rotating unducted fan N88-17666
GENERAL MOTORS CORP., INDIANAPOLIS, IND.
Gear systems for advanced turboprops N88-17667
GEOEXPLORERS INTERNATIONAL, INC., DENVER, COLO.
Geological evolution and analysis of confirmed or suspected gas hydrate localities. Volume 10: Basin analysis, formation and stability of gas hydrates of the Aleutian Trench and the Bering Sea
[DE88-001008] N88-18048
Geological evolution and analysis of confirmed or suspected gas hydrate localities. Volume 9: Formation and stability of gas hydrates of the Middle America Trench
[DE88-001007] N88-18050
GEORGE WASHINGTON UNIV., WASHINGTON, D.C.
Research on fluid dynamic energy separation
[DE88-002776] N88-18001
GEORGETOWN UNIV., WASHINGTON, D.C.
Boundary stabilization of thin elastic plates
[AD-A187123] N88-18025
GEORGIA INST. OF TECH., ATLANTA.
Clouds: A support architecture for fault tolerant, distributed systems N88-18208
GESELLSCHAFT FUER STRAHLEN- UND UMWELTFORSCHUNG M.B.H., MUNICH (WEST GERMANY).
An analytic model for ionization distributions produced in nanometer sites by protons
[DE88-003943] N88-18385
GLOBAL GEOCHEMISTRY CORP., CANOGA PARK, CALIF.
Analysis of gases in the earth's crust
[PB88-141619] N88-18093
GOSUDARSTVENNYI KOMITET PO ISPOLZOVANIYU ATOMNOI ENERGII, MOSCOW (USSR).
Flame propagation in the approximation of straight-line trajectories of burning products
[DE88-700675] N88-17756
Diffusion description of flame propagation due to the translational motion of burning reaction products
[DE88-700676] N88-17757
Tokamak with highly elongated cross-section of a plasma
[DE88-700356] N88-18412
Self-similar solutions of MHD equations of plasma filament in the case of complete degenerated ultrarelativistic electron gas
[DE88-700684] N88-18426
Comparative evaluation of resistive and inductive techniques for measuring temperature of superconducting transition
[DE88-700603] N88-18457
Onset of type 2 supernova in circumstellar envelope created by the stellar wind from presupernova
[DE88-700448] N88-18526
Neutrino magnetic moment and time variation of solar neutrino flux
[DE88-700687] N88-18542
GOSUDARSTVENNYI KOMITET PO ISPOLZOVANIYU ATOMNOI ENERGII, OBNINSK (USSR).
Quasigroup approach to solution of linear algebraic equation systems
[DE88-700595] N88-18330
GOSUDARSTVENNYJ KOMITET PO ISPOLZOVANIYU ATOMNOI ENERGII, SERPUKHOV (USSR).
On the choice of a element low-noise preamplifier on bipolar transistors
[DE88-700639] N88-17904
Hamiltonian approach to relativistic theory of gravity and to general relativity theory
[DE88-700404] N88-18492
On the time delay of the ultrahigh-energy radiation signal from the source Cygnus X-3
[DE88-700649] N88-18547
GOVERNMENT OF INDIA, NEW DELHI.
Director of R and D institutions (Government of India)
[PB88-127162] N88-17685
GRONINGEN RIJKSUNIVERSITEIT (NETHERLANDS).
Non-mythical generalization of Dekker's algorithm and its ramifications
[PB88-126321] N88-18285
GRUMMAN AEROSPACE CORP., BETHPAGE, N.Y.
An aerodynamic comparison of blown and mechanical high lift airfoils N88-17606
Micro-mechanisms of deformation in SiC/Al composites
[AD-A188282] N88-17749
GTE LABS., INC., WALTHAM, MASS.
A payload for investigating the influence of convection on GaAs crystal growth N88-17702

H

HARRIS CORP., MELBOURNE, FLA.
Solar concentrator advanced development program, task 1
[NASA-CR-179489] N88-18068
HARVARD UNIV., CAMBRIDGE, MASS.
Joint services electronics program
[AD-A187587] N88-17920
Application of Onsager's reciprocity relations to interface motion
[DE88-003286] N88-18327
Fundamental properties of spin-polarized quantum systems
[DE88-004425] N88-18499
HEALTH EFFECTS RESEARCH LAB., RESEARCH TRIANGLE PARK, N. C.
Experimental measurements of the uptake of ozone in rats and human subjects
[PB88-125422] N88-18149
HELSINKI UNIV. OF TECHNOLOGY, ESPOO (FINLAND).
Helsinki University of Technology Communications Laboratory
[PB88-112974] N88-17881
Realistic conductivity geometry model of the human head for interpretation of neuromagnetic data
[PB88-112230] N88-18179
HELSINKI UNIV. TECHNOLOGY, OTANIEMI (FINLAND).
Effect of storage thermal behavior in seasonal storage solar heating systems
[PB88-114236] N88-18067
HERZBERG INST. OF ASTROPHYSICS, OTTAWA (ONTARIO).
The photons payload, G-494: A learning experience N88-17701
HIROSHIMA UNIV., TAKEHARA (JAPAN).
Comment on the Adler-Bardeen theorem and related problems
[DE88-751051] N88-18367
HITCHCOCK INDUSTRIES, INC., MINNEAPOLIS, MINN.
Durability and damage tolerance of aluminum castings
[AD-A186444] N88-18013
HONEYWELL, INC., BLOOMINGTON, MINN.
Optical symbolic processor for expert system execution
[AD-A187494] N88-18268
HOUSTON UNIV., TEX.
High-resolution X-ray microstructural study of single crystals of YBa2Cu3O/sub 7-y/
[DE88-004856] N88-18484
HOWARD UNIV., WASHINGTON, D. C.
Laser studies of the dynamics of free radical reactions
[DE88-004431] N88-17989
HUGHES TELECOMMUNICATIONS, EL SEGUNDO, CALIF.
Spin disorder resistivity and bare Curie temperature in the ferromagnetic superconductor ErRh4B4
[DE88-003016] N88-18445

I

IBM FEDERAL SYSTEMS DIV., OWEGO, N. Y.
Why reusable software isn't N88-18212
IDAHO NATIONAL ENGINEERING LAB., IDAHO FALLS.
A collaborative program of research in engineering sciences
[DE88-003383] N88-18504
ILLINOIS UNIV. AT URBANA-CHAMPAIGN, SAVOY.
A numerical study of unsteady two-dimensional subsonic compressible base flow N88-17931
Some aspects of the mechanics and mechanisms of dynamic brittle fracture N88-18028
Applications of Lie group methods to the equations of magnetohydrodynamics N88-18422
ILLINOIS UNIV., CHICAGO.
Distributed query processing: Present status and future direction N88-18219
MBE growth, characterization and electronic device processing of HgCdTe, HgZnTe related heterojunctions and HgCdTe-CdTe superlattices
[AD-A187456] N88-18486
ILLINOIS UNIV., URBANA.
Diffusion studies in amorphous NiZr alloys
[DE88-003009] N88-17781
A distributed system architecture based on macro dataflow model N88-18210
A measurement-based study of concurrency in a multiprocessor
[DE88-003536] N88-18260
A performance analysis of architectural scalability
[DE88-003537] N88-18261
The impact of hierarchical memory systems on linear algebra algorithm design
[DE88-003574] N88-18274
PSolve: A concurrent algorithm for solving sparse systems of linear equations
[DE88-003584] N88-18275
Debugging FORTRAN on a shared memory machine
[DE88-003589] N88-18276
Using program structure to achieve prefetching for cache memories
[DE88-003599] N88-18282
A multiprocessor scheme for the singular value decomposition
[DE88-003591] N88-18288
An Ethernet local area network controller with supporting operating system software
[DE88-003534] N88-18304
The Lambda network: A new permutation network
[DE88-003568] N88-18305
Parallel access to synchronization variables
[DE88-003570] N88-18306
Loop coalescing: A compiler transformation for parallel machines
[DE88-003571] N88-18307

The performance of software-managed multiprocessor caches on parallel numerical programs [DE88-003590] N88-18308

A parallel quasi-Newton method for partially separable large scale minimization [DE88-003592] N88-18309

Dynamic processor self-scheduling for general parallel nested loops [DE88-003572] N88-18311

Parallel discrete event simulation: A shared memory approach [NASA-CR-182521] N88-18312

Deadlock prevention in processor self-scheduling for parallel nested loops [DE88-003573] N88-18313

Data prefetching in shared memory multiprocessors [DE88-003576] N88-18314

Parallel garbage collection on a virtual memory system [DE88-003567] N88-18317

Fast and practical parallel polynomial interpolation [DE88-003530] N88-18328

Fast Poisson solver on irregular regions by boundary integral-based domain decomposition methods [DE88-003583] N88-18340

Polynomial preconditioning for conjugate gradient methods [DE88-005214] N88-18342

Performance and evaluation at the Center for Supercomputing Research and Development [DE88-003563] N88-18456

Optical characterization of GaAs/sub 1-x/Sb/sub x/ and GaAs/sub 1-x/Sb/sub x/GaAs strained layer superlattices [DE88-003393] N88-18464

Center for Supercomputing Research and Development [DE88-003564] N88-18466

Transport and relaxation processes in supercritical fluids [DE88-004804] N88-18474

ILLINOIS UNIV., URBANA-CHAMPAIGN.

Towards reusable software designs and implementations N88-18213

Resilient procedures: A structured replication approach N88-18245

TABLET: The personal computer of the year 2000 [NASA-CR-182528] N88-18267

Experiences with serial and parallel algorithms for channel routing using simulated annealing [NASA-CR-182530] N88-18289

Quantitative and qualitative assessments of the impact of linguistic theory on information science N88-18507

IMPERIAL COLL. OF SCIENCE AND TECHNOLOGY, LONDON (ENGLAND).

Burst vortex/boundary layer interaction [NASA-CR-182510] N88-17583

INDIANA UNIV., BLOOMINGTON.

An applicative programmer's approach to matrix algebra, lessons for hardware and software N88-18251

Finely grained parallelism in an applicative architecture N88-18256

INDO-US SUBCOMMISSION ON SCIENCE AND TECHNOLOGY, WASHINGTON, D.C.

Minutes of the meeting of the Indo-US Subcommission on Science and Technology (8th) held at Washington, D.C. on September 22-24, 1986 [PB88-130158] N88-18503

INSTITUT NATIONAL DES SCIENCES APPLIQUEES DE LYON, VILLEURBANNE (FRANCE).

Experimental study of thermal loading at the wall of an industrial Diesel motor [ISAL-IDI-187-10] N88-18000

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Mechanistic model for void distribution in flashing flow [DE88-002948] N88-17928

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Dynamics of coupled electron-nucleon motion in a laser field [DE88-005063] N88-17994

INSTITUTE OF PAPER CHEMISTRY, APPLETON, WIS.

Ultrasonic characterization of layered composite systems N88-18374

INSTITUTO DE FISICA TEORICA, SAO PAULO (BRAZIL).

On higher derivative gravity [DE88-700619] N88-18090

Qualitative methods in nonhomogeneous cosmology [DE88-700620] N88-18458

Stellar energy loss and anomalous contributions to the (photon photon) (neutrino antineutrino) interaction [DE88-700618] N88-18529

INTEGRAL TECHNOLOGIES, INC., WESTMONT, ILL.

Effect of translucence of engineering ceramics on heat transfer in diesel engines [DE88-003732] N88-17804

Multidimensional modeling of convective heat transfer with application to IC engines [DE88-003396] N88-17948

INTERNATIONAL ATOMIC ENERGY AGENCY, VIENNA (AUSTRIA).

Training guidelines in non-destructive testing techniques [DE88-700613] N88-18019

INTERNATIONAL TECHNICAL ASSOCIATES LTD., DREXEL HILL, PA.

Rotorcraft weight trends in light of structural material characteristics [AD-A186576] N88-17642

IOWA STATE UNIV. OF SCIENCE AND TECHNOLOGY, AMES.

Interferometric study of natural convection heat transfer from a vertical flat plate with transverse roughness elements N88-17935

The numerical and analytical study of bifurcation and multicellular flow instability due to natural convection between narrow horizontal isothermal cylindrical annuli at high Rayleigh numbers N88-17937

A three-dimensional dual potential procedure for rotational flows N88-17942

Statistical studies of low frequency oscillations in satellite-observed stratospheric temperatures N88-18086

Synthesis and characterization of thin films [AD-A187335] N88-18485

IOWA UNIV., IOWA CITY.

Centerplane source distribution for slender bodies N88-17940

Free-surface flow phenomena ahead of a two-dimensional body in a viscous fluid N88-17944

Design sensitivity analysis of nonlinear structural systems and numerical implementation with established finite element codes N88-18032

ITHACO, INC., ITHACA, N.Y.

ISTP SBIR phase 1 Full-Sky Scanner: A feasibility study [NASA-CR-180749] N88-17964

J

JAPAN ATOMIC ENERGY RESEARCH INST., TOKYO.

Application of ac-impedance method on determination of corrosion rate of metals [DE88-750307] N88-17771

Plasma physics design and major specifications of candidate reactors for FER design studies. Conceptual design study of FY86 FER [DE88-751066] N88-18416

Development of tokamak reactor system analysis code NEW-TORSAC [DE88-751067] N88-18417

Conceptual design study of Fusion Experimental Reactor (FY86 FER): Safety [DE88-751071] N88-18418

JAYCOR, SAN DIEGO, CALIF.

Modeling of the non-auditory response to blast overpressure [AD-A187397] N88-18184

JET PROPULSION LAB., CALIFORNIA INST. OF TECH., PASADENA.

SAR (Synthetic Aperture Radar) imaging of ship wakes in the Gulf of Alaska [AD-A186554] N88-17872

Satellite interference analysis and simulation using personal computers [NASA-CR-182522] N88-17890

The design of trellis codes for fading channels [NASA-CR-182523] N88-17891

Recursive forward dynamics for multiple robot arms moving a common task object [NASA-CR-182526] N88-18008

Environmental projects. Volume 4: Asbestos survey [NASA-CR-182527] N88-18083

Observation model and parameter partials for the JPL VLBI parameter estimation software MASTERFIT-1987 [NASA-CR-182524] N88-18523

Deep space target location with Hubble Space Telescope (HST) and Hipparcos data [NASA-CR-182520] N88-18524

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JOHNS HOPKINS UNIV., BALTIMORE, MD.

Magnetic rare earth superlattices [DE88-003483] N88-18465

JOHNS HOPKINS UNIV., LAUREL, MD.

Evaluation of a temperature remote sensing technique [AD-A187885] N88-18053

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MICRO system for control, acquisition and processing of experimental data [DE88-700724] N88-18278

Failure-resistant Fibre-Optical Communication Line (FOCL) [DE88-700470] N88-18400

Optimization of outlet channel of plasma ion source [DE88-700471] N88-18415

On the dynamical supersymmetry of atomic hydrogen [DE88-700713] N88-18495

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Medical and psychological problems of assuring flight safety under present conditions N88-18123

Effect of spaceflight factors on primate's blood circulation N88-18124

Inflight simian circadian rhythms and temperature homeostasis aboard Cosmos-1514 biosatellite N88-18125

Effect of spaceflight factors on primate hydration homeostasis N88-18126

Embryonic development of guppy in weightlessness N88-18127

Histomorphometric analysis of rat bones after spaceflight aboard Cosmos-1667 biosatellite N88-18128

Effect of weightlessness on replicative function of rat hepatocyte DNA N88-18129

RNA-synthesizing activity in rat liver following flight aboard Cosmos-1667 N88-18130

Role of optokinetic stimulation in vestibulospinal reflexes N88-18131

Membrane model of cupula or vestibular semicircular canals N88-18132

Investigation of effects of short-term exposure to high concentrations of carbon monoxide on operator's psychophysiological functions N88-18133

Human blood glutamic acid level with exposure to high ambient concentrations of ammonia N88-18134

Analysis of water recovered after being used for washing by men and women N88-18135

Forecasting complications of cardiovascular disease in flight personnel N88-18136

Evaluation of spare room in cerebrospinal system using noninvasive methods N88-18137

Isotope methods of determining distribution and movement of blood in the body N88-18138

Muscle preservation in the study of bioenergetic effects of hypokinesia N88-18139

Short- and long-term effects of nonlethal levels of fast high-energy helium ions on retention of developed and formation of new behavioral patterns in rats N88-18140

Myosin Ca sup (2+), Mg sup (2+)-adenosine triphosphatase activity in ray myocardium following 30-day expose to 1.1 and 2.0 G N88-18141

Kinetic toxic aspect of potential use of sulfur hexafluoride in closed environments N88-18142

Comparative evaluation of orthostatic stability following immersion in horizontal and vertical positions N88-18143

Comparative evaluation of stress repsonse of rats to different methods of simulating some effects of weightlessness N88-18144

Effect of antiorthostatic position and different illumination on sensitivity of skin in upper half of the body to ultraviolet radiation N88-18145

Discrete adaptation to sensory conflict N88-18146

Second All-Union Conference on Physiology of Extreme States and Individual Protection of Man N88-18147

JPRS Report: Science and Technology. USSR: Space Biology and Aerospace Medicine, volume 21, no. 6, November - December 1987 [JPRS-USB-88-004] N88-18150

Present stage of space medicine N88-18151

Results of long-term electrocardiographic monitoring of cosmonauts N88-18152

Improvement of human tolerance to head-pelvis (+Gz) accelerations by increasing hydration N88-18153

Effect of spaceflight factors on biological material flown aboard Cosmos-1514 biosatellite N88-18154

Investigation of genetic structures of rat germ cells following flight aboard Cosmos-1514 biosatellite during their prenatal development N88-18155

Morphological and functional state of the hypothalamo-hypophyseal neurosecretory system of rats flown aboard Cosmos-1667 N88-18156
Investigation of rat skeletal muscles following short-term spaceflight aboard Cosmos-1667 biosatellite N88-18157
Morphological study of early changes in rat bones in simulated weightlessness N88-18158
Lipid peroxidation in rat tissues with exposure to antiorthostatic hypokinesia, exercise and immobilization stress N88-18159
Role of carbon dioxide in correction of coagulation hemostasis under hypoxic conditions N88-18160
Effect of cardioactive compounds on rat myocardium actomyosin following exposure to accelerations N88-18161
Morphological manifestations of primate adaptation to orthograde stalics and walking erect N88-18162
Effect of exogenous cardiosynchronized counterpulsation on human regional and central hemodynamics N88-18163
Effect of oxygen inhalation on respiratory function during exercise and exposure to added resistance to respiration N88-18164
Polar worker adaptability to Antarctic high altitudes N88-18165
Effect of external electrostatic field on catecholamine secretion by rat adrenals N88-18166
Two-dimensional static otolith model N88-18167
Combined effect of ionizing radiation and altered gas atmosphere on central nervous system N88-18168
Effect of hypercapnic-hypoxic test on cariorespiratory parameters of individuals with neurocirculatory dystonia N88-18169
Oxidative enzyme activity in healthy subjects and individuals with neurocirculatory dystonia during graded exercise N88-18170
Hemodynamic effects of beta-adrenergic blocking with obsidan in clinostatic and orthostatic positions N88-18171
New book on metabolic aspects of spaceflight stress N88-18172

K

KAMPSAX INT., COPENHAGEN (DENMARK).
Study on long term evolution towards European manned space flight. Volume 1: Executive summary [MBB-RA3-004/87-VOL-1] N88-17689

KANSAS UNIV. CENTER FOR RESEARCH, INC., LAWRENCE.
Calculation of aerodynamic characteristics of airplane configurations at high angles of attack [NASA-CR-182541] N88-17612

KATHOLIEKE UNIVERSITEIT, NIJMEGEN (NETHERLANDS).
Unidimensional Rasch model and multidimensional data: An analytic approach [PB88-105861] N88-18187

KERNFORSCHUNGSANLAGE, JUELICH (WEST GERMANY).
Magnetic rare earth superlattices [DE88-003483] N88-18465

KMS FUSION, INC., ANN ARBOR, MICH.
Performance of a photon counting microchannel plate intensifier with wedge and strip image readout [DE88-003831] N88-17970
The deposition rate dependence of plasma polymerization on the radius of curvature of the substrate [DE88-003811] N88-18429

KUHN (RICHARD E.), NEWPORT NEWS, VA.
Recommendations for ground effects research for V/STOL and STOL aircraft and associated equipment for large scale testing [NASA-CR-177429] N88-17585

KYOTO UNIV. (JAPAN).
Suppression of X-rays generated by runaway electrons in ATF [DE88-004179] N88-18440

KYOTO UNIV., UJI (JAPAN).
Benchmarks of neutral beam injection codes for stellarators [DE88-003786] N88-18428

L

LABORATOIRE D'HELIOSYNTHESE BP, LAVERA (FRANCE).
Research on a solar biotechnology based on the culture of photosynthetic cells [DE88-900129] N88-18120

LABORATOIRE D'INFORMATIQUE THEORIQUE ET PROGRAMMATION, PARIS (FRANCE).
Portable (and disposable) interpreters N88-18237

LAMONT-DOHERTY GEOLOGICAL OBSERVATORY, PALISADES, N.Y.
Data-base of Antarctic pre-Pleistocene sediment cores [PB88-124151] N88-18094

LAWRENCE LIVERMORE NATIONAL LAB., CALIF.
Maneuverable reentry vehicle trajectory footprints: Calculation and properties [DE88-004726] N88-17726
Performance of a photon counting microchannel plate intensifier with wedge and strip image readout [DE88-003831] N88-17970
Application of state-multipole Heisenberg equations to Raman excitation dynamics [DE88-003828] N88-17977
Spatially resolved X-ray laser spectra and demonstration of gain in nickel-like systems [DE88-003957] N88-17979
Flash threshold of shocked aluminum silicofluoride [DE88-003978] N88-18005
Graph transformation algorithms for array memory optimization in applicative languages [DE88-004727] N88-18283
Performance and optimization of direct implicit time integration schemes for use in electrostatic particle simulation codes [DE88-003254] N88-18381
Electronic structure of random alloys and the theory of ordering processes [DE88-004476] N88-18394
Fabrication and evaluation of transmissive multilayer optics for 8 keV X-rays [DE88-003999] N88-18402
First and second harmonic ECRH experience at gyrotron frequencies at LLNL [DE88-003998] N88-18430
Understanding and accepting fusion as an alternative energy source [DE88-004356] N88-18432
High Z interaction physics on Nova [DE88-004397] N88-18433
Design issues for a laboratory high gain fusion facility [DE88-004406] N88-18434
The stability of free-electron lasers against filamentation [DE88-004712] N88-18435
Corner compensation structures for (110) oriented silicon [DE88-003300] N88-18455
Calculated late time spectra of supernovae [DE88-003296] N88-18530
Cosmic strings: A problem or a solution [DE88-003410] N88-18535

LEHIGH UNIV., BETHLEHEM, PA.
An analysis of the motion and effects of hairpin vortices [AD-A187261] N88-17958
A modified version of the phase sensitive technique for measurements of absolute sound velocity in solids [DE88-002303] N88-18378

LOCKHEED-ADVANCED AERONAUTICS CO., VALENCIA, CALIF.
Design of supersonic Coanda jet nozzles N88-17599

LOCKHEED ENGINEERING AND MANAGEMENT SERVICES CO., INC., WASHINGTON, D.C.
USSR Space Life Sciences Digest, issue 15 [NASA-CR-3922(18)] N88-18175

LOCKHEED-GEORGIA CO., MARIETTA.
Investigations of a circulation control airfoil flowfield using an advanced laser velocimeter N88-17589
Evaluation of a research circulation control airfoil using Navier-Stokes methods N88-17591
Development of circulation control technology for powered-lift STOL aircraft N88-17608
Navigation recovery block design description [NASA-CR-182473] N88-18022

LOCKHEED MISSILES AND SPACE CO., PALO ALTO, CALIF.
Study of helium transfer technology for STICCR: Fluid management [NASA-CR-177463] N88-17720

LORAL INSTRUMENTATION, SAN DIEGO, CALIF.
A large-grain dataflow architecture N88-18207

LOS ALAMOS NATIONAL LAB., N. MEX.
Metal hydrides [DE88-005083] N88-17766
Effects of commercial cladding on the fracture behavior of pressure vessel steel plates [DE88-004333] N88-17790
EXPLO: Explosives thermal analysis computer code [DE88-001938] N88-17814
A ring model of the lasertron [DE88-004656] N88-17908
Thermal analysis of transistor packages, part 2 [DE88-005091] N88-17909
NF85: A three-dimensional, air-dynamics computer code for analyzing explosions in structures [DE88-005085] N88-17953
Conceptual designs of a 50 NM FEL (Free-Electron Laser) oscillator and a 20-40 NM SASE (Self-Amplified Spontaneous Emission) amplifier [DE88-003150] N88-17974
Emittance studies at the Los Alamos National Laboratory Free-Electron Laser (FEL) [DE88-003146] N88-17975
Preliminary injector, accelerator, and beamline design for rf-linac-driven XUV free-electron lasers [DE88-003185] N88-17983
Extension of nuclear structure data base searches for gamma-ray laser candidates [DE88-004288] N88-17985
A nuclear structure study of the proposed gamma-ray laser candidate nucleus Re-186 [DE88-004299] N88-17986
Overview of applications of Laser-Induced Breakdown Spectroscopy (LIBS) [DE88-004314] N88-17987
Bright source lasers and experiments at very high irradiance [DE88-004317] N88-17988
Vector performance of register-to-register vector computers [DE88-004013] N88-18265
Supercomputer performance: The theory, practice, and results [DE88-004697] N88-18266
The hybrid Monte Carlo Algorithm and the chiral transition [DE88-004305] N88-18341
On precision and accuracy (bias) statements for measurement procedures [DE88-004434] N88-18359
Where directed energy stands in strategic defense [DE88-005092] N88-18365
Generalized equations for emittance and field energy of high-current beams in periodic focusing [DE88-004448] N88-18372
Rovibrational spectroscopy of ArCO van der Waals complex [DE88-004291] N88-18387
Los Alamos optical materials reliability, maintainability, and exposure testing program [DE88-001953] N88-18404
Optical measurements of surface oxide layer formation on metal films [DE88-003163] N88-18405
A chemical precursor to optical damage. Studies by laser ionization mass spectrometry [DE88-004321] N88-18408
Innovative arrangements for industry/DOE laboratory collaboration in high temperature superconductivity [DE88-004320] N88-18482
Antimatter: Its history and its properties [DE88-004308] N88-18498
Fuel cell/battery hybrid vehicle assessment [DE88-005087] N88-18520
Measurements of astrophysical reaction rates for radioactive samples [DE88-004309] N88-18537
Gamma-ray and neutron spectroscopy of planetary surfaces and atmospheres [DE88-004287] N88-18541
Personal overview of solar wind 6 [DE88-003147] N88-18543

LOYOLA UNIV., CHICAGO, ILL.
Viscosity methods in optimal control of distributed systems [AD-A188086] N88-18357

LUCAS AEROSPACE LTD., BIRMINGHAM (ENGLAND).
Pumping systems and flow interfaces for rapid response electronic reheat controls N88-17665

M

MAINE UNIV., ORONO.
Adhesion of vapour phase deposited ultra-thin polyimide films on polycrystalline silver [AD-A187930] N88-17810

MARSHALL AMATEUR RADIO CLUB, HUNTSVILLE, ALA.
MARCE data evaluation N88-17693

MARTIN MARIETTA AEROSPACE, DENVER, COLO.
An investigation of parallelism in rule based systems N88-18223

MARTIN MARIETTA AEROSPACE, NEW ORLEANS, LA.
STS propellant scavenging systems study. Part 2, volume 1: Executive summary and study results [NASA-CR-179275] N88-17716

STS propellant scavenging systems study. Part 2, volume 2: Cost and WBS/dictionary
[NASA-CR-179276] N88-17717

MARTIN MARIETTA LABS., BALTIMORE, MD.
Corrosion behavior of sputter-deposited aluminum-based alloys exposed to chloride solutions
[AD-A187262] N88-17794

MARYLAND UNIV., COLLEGE PARK.
Flap-lag-torsion aeroelastic stability of a circulation control rotor in forward flight N88-17600
An overview of vision-based navigation for autonomous land vehicles 1986
[AD-A188186] N88-17640
Local bifurcation control
[AD-A187435] N88-17915
Transient cooling of a hot surface by droplets evaporation, March 1986 - March 1987
[PB88-153341] N88-17950
Optically controlled devices and ultrafast laser sources for signal processing
[AD-A187417] N88-17995
Tactile sensing and inverse problems
[AD-A187464] N88-18011
The dynamics of two coupled rigid bodies
[AD-A187592] N88-18012
Benchmark computation and finite element performance evaluation for a rhombic plate bending problem
[AD-A187402] N88-18041
The dynamics of coupled planar rigid bodies. Part 1: Reduction, equilibria and stability
[AD-A187467] N88-18042
Nonlinear filtering and large deviations: A PDE-Control theoretic approach
[AD-A187436] N88-18321
Dynamic observers as asymptotic limits of recursive filters: Special cases
[AD-A187578] N88-18324
Recent progress in the p and h-p version on the finite element method
[AD-A187254] N88-18347
The h-p version of the finite element method for problems with nonhomogeneous essential boundary condition
[AD-A187356] N88-18348
Identifiability of multivariate ARMA models
[AD-A187394] N88-18350
On observer problems for systems governed by partial differential equations
[AD-A187430] N88-18351
On an overdetermined Neumann problem
[AD-A187451] N88-18352
Small degree solutions for the polynomial Bezout equation
[AD-A187630] N88-18355
Eigenvalue problems
[AD-A188069] N88-18356
On the maneuvering of vehicles
[AD-A187632] N88-18521

MASSACHUSETTS GENERAL HOSPITAL, BOSTON.
NMR (Nuclear Magnetic Resonance) imaging for detecting binder/plasticizers in green-state structural ceramics
[DE88-003111] N88-17800

MASSACHUSETTS INST. OF TECH., CAMBRIDGE.
Speech recognition: Acoustic-phonetic knowledge acquisition and representation
[AD-A187293] N88-17893
Investigation of materials for inert electrodes in aluminum electrodeposition cells
[DE88-003380] N88-17906
Time domain wave propagation in multilayered integrated circuits
[AD-A187462] N88-17916
Formal multilevel hierarchical verification of synchronous MOS VLSI circuits
[AD-A187532] N88-17918
Study of quantum mechanical effects in deep submicron, grating-gate field effect transistors
[AD-A188283] N88-17923
Massive fine-grain parallelism in array computation: A data flow solution N88-18254
FX-87 reference manual, edition 1.0
[AD-A187031] N88-18273
Hierachical object recognition using libraries of parameterized model sub-parts
[AD-A187476] N88-18322
Stable, robust tracking by sliding mode control
[AD-A188278] N88-18358
Inversion of parabolic and paraboloidal projections
[AD-A187538] N88-18380
Forces on neutral atoms due to electromagnetic fields
[AD-A187461] N88-18396
Relaxing the brightness constancy assumption in computing optical flow
[AD-A187437] N88-18410
Freestanding films of YBa2Cu3O/sub 6.9/
[DE88-003995] N88-18471
Brittle to ductile transition to cleavage fracture
[DE88-004074] N88-18481
A collaborative program of research in engineering sciences
[DE88-003383] N88-18504

MASSACHUSETTS INST. OF TECH., LEXINGTON.
Status of FAA terminal Doppler weather radar programs N88-17632
A two-stage isolated-word recognition system using discriminant analysis
[AD-A187425] N88-18360

MASSACHUSETTS UNIV., AMHERST.
Thermoplastic elastomers as LOVA binders
[AD-A186563] N88-17797

MATERIALS RESEARCH LABS., ASCOT VALE (AUSTRALIA).
Trace analysis by MS/MS on a double focussing mass spectrometer
[AD-A187954] N88-17973

MATRA ESPACE, TOULOUSE (FRANCE).
Study on long term evolution towards European manned space flight. Volume 1: Executive summary
[MBB-RA3-004/87-VOL-1] N88-17689

MAX-PLANCK INST., GRENOBLE (FRANCE).
Spin disorder resistivity and bare Curie temperature in the ferromagnetic superconductor ErRh4B4
[DE88-003016] N88-18445

MAX-PLANCK-INST. FUER METALLFORSCHUNG, STUTTGART (WEST GERMANY).
Models for ionic transport in glass
[DE88-002860] N88-17799

MAX-PLANCK-INST. FUER PHYSIK UND ASTROPHYSIK, GARCHING (WEST GERMANY).
The formation of single millisecond pulsars in globular clusters
[MPE-PREPRINT-97] N88-18525

MAX-PLANCK-INST. FUER PHYSIK UND ASTROPHYSIK, MUNICH (WEST GERMANY).
Design of a charge sensitive preamplifier on high resistivity silicon
[DE88-003491] N88-17907

MCDONNELL-DOUGLAS RESEARCH LABS., ST. LOUIS, MO.
Ytterbium monolayer diffusion barriers at Hg(1-x)Cd(x)Te/Al junctions
[AD-A188013] N88-17768
Local stoichiometry and atomic interdiffusion during reactive metal/mercury-cadmium-telluride junction formation
[AD-A187554] N88-18488
Nonmonotonic evolution and thermodynamic trends at metal/(Hg,Cd)Te interfaces: Yb/Hg0.78Cd0.22Te
[AD-A187591] N88-18490

MECHANICAL TECHNOLOGY, INC., LATHAM, N. Y.
Free-piston Stirling engine diaphragm-coupled heat-actuated heat pump component technology program, phase 1C
[DE88-003654] N88-17949

MELBOURNE UNIV., PARKVILLE (AUSTRALIA).
Electron transfer to iron(3) oxide colloids
[DE88-002885] N88-18448

MESOSCALE ENVIRONMENTAL SIMULATIONS, INC., HAMPTON, VA.
NASA wind shear model: Summary of model analyses N88-17617

MESSERSCHMITT-BOELKOW-BLOHM G.M.B.H., BREMEN (WEST GERMANY).
Study on long term evolution towards European manned space flight. Volume 1: Executive summary
[MBB-RA3-004/87-VOL-1] N88-17689
Rendezvous and docking verification and demonstration in orbit, executive summary
[MBB-303-16/86] N88-17719
The intelligent wing. Aerodynamic development direction for future passenger aircraft
[MBB-UT-006/87] N88-17848
The application of modern aeroelastic developments for future projects
[MBB-UT-007/87] N88-17850
An expert system to support the verification/validation of flight-critical software
[MBB-UT-102/87] N88-17852
Project management in astronautics: From Spacelab to Columbus
[MBB-URE-943/87] N88-17858

MESSERSCHMITT-BOELKOW-BLOHM G.M.B.H., HAMBURG (WEST GERMANY).
Light Electronic Control System (LECOS): A proposal for a interconnected error-tolerant, optoelectronic control system
[MBB-UT-004/87] N88-17836
Airbus, the successful European cooperation
[MBB-UT-005/87] N88-17847
Product planning in civil aircraft construction
[MBB-UT-002/87] N88-17849
Trends in the distribution of tasks between commercial pilots and flight control systems
[MBB-UT-008/87] N88-17851

MESSERSCHMITT-BOELKOW-BLOHM G.M.B.H., OTTOBRUNN (WEST GERMANY).
Research and development. Technical-scientific publications (1956-1987): Retrospective view and prospects. Jubilee edition on the occasion of the 75th birthday of Dipl.-Engr. Dr.-Engr. E. H. Ludwig Boelkow
[ISSN-0931-9751] N88-17819
Research, development, and growth strategy N88-17820
Special flight mechanical features of the bearingless helicopter rotor
[MBB-FM-315/O] N88-17825
AZUR, the first German research satellite 625-A, 1964-1969 N88-17827
Ballistic Single Stage Carrier Vehicle (BETA): A single stage reusable ballistic space shuttle concept
[MBB-UR-949/70] N88-17828
Cooperation know-how in high-tech products
[MBB-Z-101/86] N88-17833
The mathematization of the military sciences
[MBB-Z-139/87] N88-17834
Operations research in management?
[MBB-Z-138/87] N88-17835
Calculation of the spatial-temporal deformation of laser pulses in multiple scattering
[MBB-Z-111/87] N88-17837
The mechanism of anisotropic silicon etching and its relevance for micromachinings
[MBB-UA-1013/86] N88-17838
Modern materials for light constructions
[MBB-Z-136/86] N88-17839
New scientific findings on the morphology of aluminum oxide layers, serving as an adhesive basis
[MBB-Z-137/86] N88-17840
Silencium resonators (Silators) for the attenuation and elimination of sound
[MBB-Z-546/83] N88-17841
Purposes and tasks of high-performance aircraft construction
[MBB/LK-S/PUB/296] N88-17842
Future fighter maneuverability for air combat
[MBB/LKE-1/S/PUB/120] N88-17843
Flight testing of fighter aircraft
[MBB/LKE-62/S/PUB/292] N88-17844
Active control technology with adaptive control concept in the aircraft construction
[MBB/LKE-294/S/PUB/295] N88-17845
Zonal solutions for viscous flow problems. Finite approximations in fluid mechanics
[MBB/LKE-122/S/PUB/226] N88-17846
Helicopter activities in Germany
[MBB-UD-487/86] N88-17853
Testing of a tail rotor system in a fiber composite type of construction
[MBB-UD-472/86] N88-17854
Rotor SAR (ROSAR): A new high-resolution all-weather vision method for helicopters
[MBB-UA-1046/87] N88-17855
The prospects of space utilization
[MBB-UR-931/86] N88-17856
Trends in the development of space transportation systems
[MBB-UR-911/86] N88-17857
Three-dimensional Euler solutions for hypersonic Mach numbers
[MBB-UR-944/87] N88-17859
The military techniques of tomorrow. A contribution to active peace assurance
[MBB-UA-1049/87] N88-17860
POLYPHEM, a universal defensive missile with optical waveguides guidance
[MBB-UA-1045/87] N88-17862
Aerodynamic aspects of the configurational systems layout of a dispenser
[MBB-UA-1047/87] N88-17863
Experiments for the high resolution detection of moving targets using a CO2 laser radar
[MBB-UA-1044/87] N88-17864
The MBB propulsion concepts for magnetic suspension railways: Retrospective view and prospects
[MBB-Z-141/87] N88-17865
Messerschmitt-Boelkow-Blohm: A company with a tradition N88-17866
Messerschmitt-Boelkow-Blohm: Biography and history of a company N88-17867
Messerschmitt-Boelkow-Blohm, the company today. Data, numbers and facts N88-17868

MESSERSCHMITT-BOELKOW-BLOHM G.M.B.H., SCHROBENHAUSEN (WEST GERMANY).
Penetration theory for inclined and moving shaped charges
[MBB-UA-940/86] N88-17861

MIAMI UNIV., FLA.
A deep-water OBS (Ocean Bottom Seismometer) array with real-time telemetry
[AD-A187404] N88-18112
MICHIGAN STATE UNIV., EAST LANSING.
Dynamic recrystallization during high temperature low cycle fatigue of nickel
[DE88-003224] N88-17788
Reuse: A Reliable Unified Service Environment for distributed systems N88-18231
MICHIGAN UNIV., ANN ARBOR.
Turbulence interactions in single- and multi-phase turbulent mixing and combustion processes
[AD-A187505] N88-17960
Collaborative studies of polar cap ionospheric dynamics
[AD-A187888] N88-18098
The next generation of hypercube computers N88-18226
On the number of task assignments in distributed computing systems N88-18230
MICROELECTRONICS AND COMPUTER TECHNOLOGY CORP., AUSTIN, TEX.
Future directions in computer architecture and software: The year 2000 N88-18218
MIDWEST RESEARCH INST., GOLDEN, COLO.
Wake effects in a Fayette 95-IIS wind turbine array
[DE88-001103] N88-18063
Experimental studies of heat and mass exchange in parallel-passage rotary desiccant dehumidifiers for solar cooling applications
[DE88-001119] N88-18069
Preliminary results from the dynamic response testing of the Westinghouse 600-kW wind turbine
[DE88-001123] N88-18070
Turbulence loads on the Howden 26-m-diameter wind turbine
[TI88-001118] N88-18075
MINNESOTA UNIV., MINNEAPOLIS.
Ytterbium monolayer diffusion barriers at Hg(1-x)Cd(x)Te/Al junctions
[AD-A188013] N88-17768
A solar receiver-reactor with specularly reflecting walls for high-temperature thermoelectrochemical and thermochemical processes
[AD-A187612] N88-18077
State-to-state dynamics of molecular energy transfer
[DE88-003282] N88-18362
Microscopic control of metallization stability
[AD-A187553] N88-18487
Local stoichiometry and atomic interdiffusion during reactive metal/mercury-cadmium-telluride junction formation
[AD-A187554] N88-18488
Superconductivity of thin film intermetallic compounds
[AD-A187563] N88-18489
Nonmonotonic evolution and thermodynamic trends at metal/(Hg,Cd)Te interfaces: Yb/Hg0.78Cd0.22Te
[AD-A187591] N88-18490
CdTe(110)-Mn interface reaction and the formation of non-equilibrium ternary semimagnetic semiconductor alloys
[AD-A187593] N88-18491
MISSOURI UNIV., COLUMBIA.
A comparative study of heurstic algorithms for task assignment in distributed computing systems N88-18211
MISSOURI UNIV., ROLLA.
Short fiber reinforced thermoplastic composites for armor applications: Interfacial bonding
[DE88-004007] N88-17742
MONASH UNIV., CLAYTON (AUSTRALIA).
Aspects of a multiprocessor architecture N88-18232
MORETON HALL ASSOCIATES, MAIDENHEAD (ENGLAND).
Study for history of technology developments in European space projects
[REPT-8518-1] N88-17690
MOTOREN- UND TURBINEN-UNION MUENCHEN G.M.B.H. (WEST GERMANY).
An integrated aero/mechanical performance approach to high technology turbine design N88-17657
MOUND LAB., MIAMISBURG, OHIO.
Transmission electron microscopy studies of titanium-containing braze/alumina seals
[DE88-005243] N88-17792
Metal modification for improved glass-ceramic to metal seals: 1. Auger results on ion implantation and vapor deposition films
[DE88-005244] N88-18006

N

NAGOYA UNIV. (JAPAN).
D-3He fuels in a field-reversed configuration
[IPPJ-855] N88-18419
New mode conversion process and overdense plasma heating in the electron cyclotron range of frequencies
[IPPJ-854] N88-18420
NATIONAL ACADEMY OF SCIENCES - NATIONAL RESEARCH COUNCIL, WASHINGTON, D. C.
Report of the Committee on the Space Station of the National Research Council
[NASA-CR-181602] N88-17727
Earth materials research: Report of a Workshop on Physics and Chemistry of Earth Materials
[NASA-CR-182519] N88-17761
Interdisciplinary research in mathematics, science and technology education
[PB88-131446] N88-18333
NATIONAL AERONAUTICS AND SPACE ADMINISTRATION, WASHINGTON, D.C.
AXAF: The Advanced X-ray Astrophysics Facility
[NASA-EP-251(M)] N88-17725
Electrically conducting polymer-copper sulphide composite films, preparation by treatment of polymer-copper (2) acetate composites with hydrogen sulfide
[NASA-TT-20204] N88-17803
Space-based remote sensing of the Earth: A report to the Congress
[NASA-TM-89709] N88-18046
Earth resources: A continuing bibliography with indexes (supplement 56)
[NASA-SP-7041(56)] N88-18051
Into the thermosphere: The atmosphere explorers
[NASA-SP-490] N88-18084
NASA Oceanic Processes Program
[NASA-TM-4025] N88-18109
Aerospace medicine and biology: A cumulative index to a continuing bibliography (supplement 306)
[NASA-SP-7011(306)] N88-18180
Certain aspects of human metabolism during spaceflights of varying duration
[NASA-TT-20215] N88-18181
Basic results of medical studies during prolonged manned flights on-board the Salyut-7/Soyuz-T orbital complex
[NASA-TT-20217] N88-18182
Aerospace medicine and biology: A continuing bibliography with indexes (supplement 308)
[NASA-SP-7011(308)] N88-18183
The band systems of alkali vapors
[NASA-TT-20206] N88-18462
NASA patent abstracts bibliography: A continuing bibliography. Section 2: Indexes (supplement 32)
[NASA-SP-7039(32)-SECT-2] N88-18511
NATIONAL AERONAUTICS AND SPACE ADMINISTRATION. AMES RESEARCH CENTER, MOFFETT FIELD, CALIF.
Application of empirical and linear methods to VSTOL powered-lift aerodynamics
[NASA-TM-100048] N88-17581
Navier-Stokes simulation of wind-tunnel flow using LU-ADI factorization algorithm
[NASA-TM-100042] N88-17584
Proceedings of the Circulation-Control Workshop, 1986
[NASA-CP-2432] N88-17586
Navier-Stokes calculations and turbulence modeling in the trailing edge region of a circulation control airfoil N88-17587
Navier-Stokes computations for circulation control airfoils N88-17592
On the effect of leading edge blowing on circulation control airfoil aerodynamics N88-17595
Pressure distributions and oil-flow patterns for a swept circulation-control wing N88-17596
Boundary-layer and wake measurements on a swept, circulation-control wing N88-17597
Reduction of tilt rotor download using circulation control N88-17605
A potential flight evaluation of an upper-surface-blowing/circulation-control-wing concept N88-17609
Information transfer in the National Airspace System N88-17634
Are windshear training aid recommendations appropriate for other than large jet transports? Pilot procedures: Shear models N88-17635
X-29A forward-swept-wing flight research program status
[NASA-TM-100413] N88-17644
Transport delay compensation for computer-generated imagery systems
[NASA-TM-100084] N88-17645
Using frequency-domain methods to identify XV-15 aeroelastic modes
[NASA-TM-100033] N88-17646
High-temperature properties of ceramic fibers and insulations for thermal protection of atmospheric entry and hypersonic cruise vehicles
[NASA-TM-100059] N88-17743
NASA Workshop on Biological Adaptation
[NASA-TM-89468] N88-18174
Orthogonal patterns in binary neural networks
[NASA-TM-100060] N88-18320
A study of numerical methods for hyperbolic conservation laws with stiff source terms
[NASA-TM-100075] N88-18343
Hypersonic blunt body computations including real gas effects
[NASA-TM-100074] N88-18344
Linear prediction of stationary vector sequences
[NASA-TM-100069] N88-18366
Networking requirements and future alternatives
[NASA-TM-89711] N88-18517
NATIONAL AERONAUTICS AND SPACE ADMINISTRATION. GODDARD SPACE FLIGHT CENTER, GREENBELT, MD.
The 1987 Get Away Special Experimenter's Symposium
[NASA-CP-2500] N88-17691
Electrochemical growth of linear conducting crystals in microgravity N88-17698
GAS eleven node thermal model (GEM) N88-17712
NATIONAL AERONAUTICS AND SPACE ADMINISTRATION. JOHN F. KENNEDY SPACE CENTER, COCOA BEACH, FLA.
Species biology and potential for controlling four exotic plants (Ammophila arenaria, Carpobrotus edulis, Cortaderia jubata and Gasoul crystallinum) on Vandenberg Air Force Base, California
[NASA-TM-100980] N88-18148
Relationships between coronary heart disease risk factors and serum ionized calcium in Kennedy Space Center Cohort
[NASA-TM-100979] N88-18177
Research and technology 1987 annual report of the Kennedy Space Center
[NASA-TM-100303] N88-18548
NATIONAL AERONAUTICS AND SPACE ADMINISTRATION. LANGLEY RESEARCH CENTER, HAMPTON, VA.
A transonic-small-disturbance wing design methodology
[NASA-TP-2806] N88-17614
Supersonic aerodynamics of delta wings
[NASA-TP-2771] N88-17615
Airborne Wind Shear Detection and Warning Systems: First Combined Manufacturers' and Technologists' Conference
[NASA-CP-10006] N88-17616
Response of wind shear warning systems to turbulence with implication of nuisance alerts N88-17618
Investigation of the influence of wind shear on the aerodynamic characteristics of aircraft using a vortex-lattice method N88-17619
Windshear warning aerospatiale approach N88-17620
Airborne Doppler radar technology for wind shear detection N88-17622
Lidar windshear detection and avoidance: Performance and technical assessment N88-17626
Simulator investigation of wind shear recovery techniques N88-17630
An application of eigenspace methods to symmetric flutter suppression
[NASA-CR-181618] N88-17684
Planet X probe: A fresh new look at an old familiar place N88-17699
A fiber-resin micromechanics analysis of the delamination front in a DCB specimen
[NASA-TM-100540] N88-17737
An analytical study of the effects of transverse shear deformation and anisotropy on natural vibration frequencies of laminated cylinders
[NASA-TM-100554] N88-17739
Leeside crossflow modeling in Euler space-marching computations
[NASA-TM-89710] N88-17924
On the interaction of Tollmein-Schlichting waves in axisymmetric supersonic flows
[NASA-CR-181619] N88-17955
Parameter identification and sensitivity analysis for a robotic manipulator arm
[NASA-CR-181608] N88-18272
Introduction to a system for implementing neural net connections on SIMD architectures
[NASA-CR-181612] N88-18279

A visual programming environment for the Navier-Stokes computer
[NASA-CR-181615] N88-18299
Implementation and analysis of a Navier-Stokes algorithm on parallel computers
[NASA-CR-181614] N88-18301
An efficient sparse matrix multiplication scheme for the CYBER 205 computer
[NASA-TM-4028] N88-18302
Leapfrog variants of iterative methods for linear algebra equations
[NASA-CR-181616] N88-18332
Domain decomposition preconditioners for the spectral collocation method
[NASA-CR-181620] N88-18345
A unified framework for approximation in inverse problems for distributed parameter systems
[NASA-CR-181621] N88-18346
Laser production and heating of plasma for MHD application
[NASA-TP-2798] N88-18443

NATIONAL AERONAUTICS AND SPACE ADMINISTRATION. LEWIS RESEARCH CENTER, CLEVELAND, OHIO.
Experimental evaluation of a translating nozzle sidewall radial turbine N88-17656
Experimental evaluation of turning vane designs for high-speed and coupled fan-drive corners of 0.1-scale model of NASA Lewis Research Center's proposed altitude wind tunnel
[NASA-TP-2681] N88-17686
Simulation test beds for the space station electrical power system
[NASA-TM-100786] N88-17715
Magnetic emissions testing of the space station engineering model resistojet
[NASA-TM-100788] N88-17728
Mechanics of composite materials: Past, present and future
[NASA-TM-100793] N88-17744
Finite element substructuring methods for composite mechanics
[NASA-TM-100297] N88-17745
Friction and wear of monolithic and fiber reinforced silicon-ceramics sliding against IN-718 alloy at 25 to 800 C in atmospheric air at ambient pressure
[NASA-TM-100294] N88-17796
Adhesion, friction and micromechanical properties of ceramics
[NASA-TM-100782] N88-17801
Modeling of some coplanar waveguide discontinuities
[NASA-TM-100808] N88-17880
Complementary satellite sound broadcasting systems: A NASA assessment for the Voice of America
[NASA-TM-100300] N88-17899
Ceramic bearings for use in gas turbine engines
[NASA-TM-100288] N88-18007
Vibration and flutter characteristics of the SR7L large-scale propfan
[NASA-TM-100272] N88-18036
Relationship between fatigue life in the creep-fatigue region and stress-strain response
[NASA-TM-100796] N88-18040
An estimate of the noise shielding on the fuselage resulting from installing a short duct around an advanced propeller
[NASA-TM-100262] N88-18379

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A generalized method for automatic downhand and wirefeed control of a welding robot and positioner
[NASA-TP-2807] N88-17869
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[MBB-RA3-004/87-VOL-1] N88-17689

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[NAL-TR-943] N88-17613
Formulation methods of rigid multibody systems for large space structures and some results of computer simulation
[NAL-TR-942] N88-17730
CARS measurements of combustion. 1: Precision of thermometry
[NAL-TR-939] N88-17769
Analysis of a turbulent premixed V-flame (influence of flame-thickening)
[NAL-TR-941] N88-17770
Flow patterns induced by vortices
[NAL-TR-932] N88-17963
Study on a rotor speed control system for a horizontal axis windmill
[NAL-TR-931] N88-18062

NATIONAL BUREAU OF STANDARDS, BOULDER, COLO.
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[PB88-155791] N88-17885

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[PB88-123757] N88-17905
Effect of the gate oxide thickness on the speed of MOS integrated circuits
[PB88-155783] N88-17910
NBS (National Bureau of Standards) measurement services: Platinum resistance thermometer calibrations
[PB88-138367] N88-17967
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[NASA-TM-89709] N88-18048

NATIONAL RESEARCH COUNCIL OF CANADA, OTTAWA (ONTARIO).
A research program on the aerodynamics of a highly loaded turbine stage N88-17655

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Response of Fe-Cr-Mn austenitic alloys to thermal aging neutron irradiation
[DE88-003415] N88-17785

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[PB88-116116] N88-17874
User's guide for the HF (High Frequency) broadcast antenna design and validation summary programs
[PB88-116124] N88-17875

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[PB88-135843] N88-17638
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[PB88-114038] N88-17873
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[PB88-115662] N88-18101

NAVAL AEROSPACE MEDICAL RESEARCH LAB., PENSACOLA, FLA.
The accommodative status in the dark of US Navy fighter pilots
[AD-A188188] N88-18186

NAVAL OCEAN RESEARCH AND DEVELOPMENT ACTIVITY, BAY ST. LOUIS, MISS.
Rapid underway sediment classification by electrical methods
[AD-A187447] N88-18113
Rapid underway sediment classification by electrical methods
[AD-A187477] N88-18114
Energy transfers for multilayer hydrodynamic ocean models: General formulation and specific examples
[AD-A187604] N88-18116

NAVAL OCEAN SYSTEMS CENTER, SAN DIEGO, CALIF.
The design of Impedance- matching networks for broadband antennas
[AD-A187600] N88-17895

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[AD-A188264] N88-18107

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Methods of eliciting information from experts
[AD-A187468] N88-18189

NAVAL POSTGRADUATE SCHOOL, MONTEREY, CALIF.
Investigation of dynamic stall using LDV (Laser Doppler Velocimetry): Mean flow studies
[AD-A187629] N88-17611
Investigation of design considerations for Telemetry, Tracking and Command (TT and C) antenna system on Naval Postgraduate School Orion mini-satellite
[AD-A187130] N88-17718
Preliminary design of the ORION attitude control system
[AD-A187179] N88-17729
NROSS (Navy Remote Ocean Sensing System): A force multiplier
[AD-A186853] N88-18045
Numerical simulations of the California current: Filament formation as related to baroclinic instability
[AD-A187573] N88-18115
Experience with Omega: Implementation of a prototype programming environment, part 6
[AD-A187060] N88-18270
Deriving abstractions from a software object network
[AD-A187472] N88-18294
Design and implementation of a fiber optic RS232 link
[AD-A187319] N88-18409
Optical memory cards: A comparison with other current technologies and potential military applications
[AD-A187287] N88-18512
A comparison of projection methods in the forecasting of overhead costs for seven government aerospace contractors
[AD-A187572] N88-18514

NAVAL RESEARCH LAB., WASHINGTON, D.C.
Detection of signals in non-Gaussian correlated noise derived from Cauchy processes
[AD-A187488] N88-17894
Tapered wiggler analysis of high gain free electron laser oscillators
[AD-A187997] N88-17997
The influence of small defects on tensile specimen ductility and symmetry of deformation
[AD-A187983] N88-18044

Theoretical and observational problems with Holes in the far UV dayglow
[AD-A188190] N88-18100
A framework for evaluating computer architectures to support systems with security requirements, with applications
[AD-A187082] N88-18303
Electronic structure of random alloys and the theory of ordering processes
[DE88-004476] N88-18394
Multidimensional system analysis of electro-optic sensors with sampled deterministic output
[AD-A187083] N88-18399
Coronal heating by means of helical magnetohydrodynamic turbulence
[AD-A187084] N88-18413

NAVAL SHIP RESEARCH AND DEVELOPMENT CENTER, BETHESDA, MD.
Analysis of a fixed-pitch X-wing rotor employing lower surface blowing N88-17602
Fixed wing CCW aerodynamics with and without supplementary thrust deflection N88-17607

NAVAL SURFACE WEAPONS CENTER, SILVER SPRING, MD.
Fundamental cyclotron frequency generation from a cusptron oscillator
[AD-A188187] N88-17898

NAVAL UNDERWATER SYSTEMS CENTER, NEW LONDON, CONN.
Systolic array adaptive beamforming
[AD-A187496] N88-18269

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Positron-annihilation 2D-ACAR studies of disordered and defected alloys
[DE88-003118] N88-18454

NEW HAMPSHIRE UNIV., DURHAM.
Gamma-ray imaging observations of the Crab and Cygnus regions N88-18522

NEW MEXICO UNIV., ALBUQUERQUE.
Evaluation of bituminous materials used in pavement recycling projects at Tyndall, MacDill, and Hurlburt Air Force Bases
[AD-A188068] N88-17871
Vector bundles over real algebraic varieties
[PB88-126577] N88-18335

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Investigations on the usefulness of the Massively Parallel Processor for study of electronic properties of atomic and condensed matter systems
[NASA-CR-182514] N88-18259

NEW YORK UNIV., NEW YORK.
Three-dimensional incompressible flowfield analysis for establishing rotor designs which optimize power extraction N88-17943
Energy-related atomic and molecular structure and scattering studies
[DE88-004246] N88-18386

NORFOLK PUBLIC SCHOOLS, VA.
The NORSTAR Program: Space shuttle to space station N88-17710

NORGES TEKNISKE HOEGSKOLE, TRONDHEIM.
Radial compressor design using an Euler solver N88-17675

NORTH CAROLINA STATE UNIV., RALEIGH.
The case for a shared address space N88-18225
An anlysis of the reliability of tree-structured interconnection networks N88-18228
Programming language translation for multicomputers N88-18244

NORTH CAROLINA UNIV., CHAPEL HILL.
Semantics of Eql.
[AD-A188151] N88-18297
A hypertext writing environment and its cognitive basis
[AD-A188179] N88-18298
Shared workspaces for real-time collaboration in distributed networks: Concepts, techniques, problems
[AD-A188150] N88-18315
Explicit solutions of moment problems, 1
[AD-A188018] N88-18325
Probability bounds for M-Skorohod oscillations
[AD-A187981] N88-18371
Research in theoretical physics: Results from last year 1986/87
[DE88-004922] N88-18502

NORTH CAROLINA UNIV., RALEIGH.
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[AD-A184949] N88-18191

NORTHEASTERN UNIV., BOSTON, MASS.
Radar returns from ground clutter in vicinity of airports N88-17624
Positron-annihilation 2D-ACAR studies of disordered and defected alloys
[DE88-003118] N88-18454

NORTHROP CORP., HAWTHORNE, CALIF.
Durability and damage tolerance of aluminum castings
[AD-A186444] N88-18013

NORTHWESTERN UNIV., EVANSTON, ILL.
Automated data flow diagram verification N88-18255
Electronic structure, charge transfer excitations and high temperature superconductivity
[DE88-003096] N88-18453

NOVA UNIV., DANIA, FLA.
Five-diagonal weighting scheme for geoidal profiles
[AD-A188033] N88-18054

NUCLEP, RIO DE JANEIRO (BRAZIL).
Influence of non-metallic elements in the mechanical properties of 20 Mn Mo Ni 55 steel
[DE88-700412] N88-17775

O

OAK RIDGE GASEOUS DIFFUSION PLANT, TENN.
Ultra-low frequency vibration data acquisition concerns in operating flight simulators
[DE88-004795] N88-17687
Computer-Aided Design Information System (CADIS): User's manual
[DE88-004365] N88-18509

OAK RIDGE NATIONAL LAB., TENN.
Ultra-low frequency vibration data acquisition concerns in operating flight simulators
[DE88-004795] N88-17687
Optimization of the southern electrophoretic transfer method
[DE88-004527] N88-17785
An experiment to investigate Rankine cycle two-phase microgravity issues
[DE88-004197] N88-17818
Capacitor analysis for RF antennas
[DE88-004178] N88-17883
Johnson noise thermometer for high radiation and high temperature environments
[DE88-003770] N88-17911
Dynamics of coupled electron-nucleon motion in a laser field
[DE88-005063] N88-17994
Scaling physiological pharmacokinetic models by physiological time
[DE88-000335] N88-18173
Application of Onsager's reciprocity relations to interface motion
[DE88-003286] N88-18327
Application of ECR ion source beams in atomic physics
[DE88-003767] N88-18384
Two-photon (VUV and visible) resonant ionization spectroscopy of atoms and molecules
[DE88-004332] N88-18388
Absolute rate measurements of two-photon process of gases, liquids, and solids
[DE88-003800] N88-18391
Electronic structure of random alloys and the theory of ordering processes
[DE88-004476] N88-18394
Advances in calculating macroionic solution structure
[DE88-003799] N88-18406
Formation of optical waveguides by ion implantation
[DE88-003894] N88-18407
Evaluation of magnetic coordinates in finite-beta, asymmetric plasmas
[DE88-003665] N88-18424
Benchmarks of neutral beam injection codes for stellarators
[DE88-003786] N88-18428
Asymmetric double Langmuir probe for fast and automatic measurements of plasma temperature
[DE88-004773] N88-18436
Diagnostics for ATF
[DE88-004175] N88-18438
ATF experimental plans
[DE88-004177] N88-18439
Suppression of X-rays generated by runaway electrons in ATF
[DE88-004179] N88-18440
Study of resistive pressure-gradient-driven turbulence
[DE88-005062] N88-18441
Magnetic rare earth superlattices
[DE88-003483] N88-18465
Air Force geographic information and analysis system
[DE88-001420] N88-18505
Guidelines for exchanging computerized information
[DE88-004736] N88-18510

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SAR (Synthetic Aperture Radar) imaging of ship wakes in the Gulf of Alaska
[AD-A186554] N88-17872

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Design and testing of a small radial turbine for auxiliary power units N88-17661
Analysis of highspeed propellers aerodynamics N88-17669

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[AD-A188092] N88-17795
Durability and damage tolerance of aluminum castings
[AD-A186444] N88-18013
Perception and control of simulated self motion
[AD-A187444] N88-18188
Concurrency control and reliability in replicated database systems N88-18221

OKLAHOMA UNIV., NORMAN.
Precipitation of surfactants and surfactant mixtures in aqueous solutions
[DE88-003333] N88-17763

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Magnetic control of low pressure discharges
[AD-A186794] N88-17900
Strategies for concurrent processing of complex algorithms N88-18236

ORBITAL SYSTEMS LTD., LANHAM, MD.
The challenge of G-376 N88-17705

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[AD-A187580] N88-18052

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OTTAWA UNIV. (ONTARIO).
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[AD-A188020] N88-17962

P

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Response of Fe-Cr-Mn austenitic alloys to thermal aging neutron irradiation
[DE88-003415] N88-17785
Effects of the neutron spectrum on mechanical property changes in low dose irradiations
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Microcomputer analysis of regenerative heat exchangers for oscillating flow
[DE88-001773] N88-17945
Advanced materials for solid oxide fuel cells
[DE88-002338] N88-18071
Evaluation of regional-scale air quality models: Chairmen reports from four workshops
[DE88-001397] N88-18080
An analytic model for ionization distributions produced in nanometer sites by protons
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Cape Blanco wind farm feasibility study
[DE88-003748] N88-18059

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Boundary value problems for differential and functional differential equations
[AD-A187378] N88-18349

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Mechanisms of wear in single- and two-phase materials
[DE88-003846] N88-17806
Experimental research on swept shock wave/boundary layer interactions
[AD-A187250] N88-17957
A paradigm for concurrency control performance evaluation N88-18220
Zero-dimensional model of a reversed field pinch fusion reactor
[DE88-005213] N88-18442

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New generation imager system
[NASA-CR-180464] N88-18398

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PRATT AND WHITNEY AIRCRAFT, WEST PALM BEACH, FLA.
Design and development of an advanced F100 compressor N88-17678
PRATT AND WHITNEY AIRCRAFT OF CANADA LTD., LONGUEUIL (QUEBEC).
Design and aerodynamic performance of a small mixed-flow gas generator turbine N88-17662
PRINCETON UNIV., N. J.
Solution of the three-dimensional Navier-Stokes equations for transonic flow using a multigrid method N88-17579
Development and application of oxygen flow tagging for velocity measurements and flow visualization in turbulent three-dimensional supersonic flows
[AD-A187982] N88-17714
The structure and control of three-dimensional shock wave turbulent boundary layer interactions
[AD-A187642] N88-17961
Apparatus for the study of silicon film deposition and silicon etching
[AD-A187616] N88-17972
The design of load balancing strategies for distributed systems N88-18216
PURDUE UNIV., WEST LAFAYETTE, IND.
The mapping of parallel algorithms to reconfigurable parallel architectures N88-18209
Sound transmission through the walls of light aircraft: An investigation of structure-borne noise in a Handley Page 137 Jetstream 3 aircraft
[NASA-CR-182509] N88-18376
Spin disorder resistivity and bare Curie temperature in the ferromagnetic superconductor ErRh4B4
[DE88-003016] N88-18445
Optical characterization of GaAs/sub 1-x/Sb/sub x/ and GaAs/sub 1-x/Sb/sub x/GaAs strained layer superlattices
[DE88-003393] N88-18464
CdTe(110)-Mn interface reaction and the formation of non-equilibrium ternary semimagnetic semiconductor alloys
[AD-A187593] N88-18491

R

RADIO CORP. OF AMERICA, MOORESTOWN, N. J.
High-performance CPU implementation of the nebula instruction set architecture N88-18194
REDSTONE SCIENTIFIC INFORMATION CENTER, REDSTONE ARSENAL, ALA.
Project Explorer takes its second step: GAS-608 in engineering development N88-17707
RENSSELAER POLYTECHNIC INST., TROY, N.Y.
Analytical and experimental characterization of damage processes in composite laminates
[AD-A187221] N88-17746
Advanced energy conversion concept for beamed-energy propulsion
[AD-A187336] N88-17914
Predicate analysis for parallel program generation N88-18222
A parallel computer based on cube connected cycles N88-18227
Wafer scale implementation of a GaAs systolic signal processor cell N88-18247
RESEARCH TRIANGLE INST., HAMPTON, VA.
Wind shear radar simulation N88-17625
RICE UNIV., HOUSTON, TEX.
Experiments with parallel program execution on a network of workstations N88-18217
Nuclear structure at intermediate energies
[TI88-002796] N88-18390
An analysis of longitude variations in the equatorial spectrum of Saturn N88-18539
RISO NATIONAL LAB., ROSKILDE (DENMARK).
Magnetic rare earth superlattices
[DE88-003483] N88-18465
ROCHESTER UNIV., N. Y.
Nonlinear optics with broad-band lasers
[DE88-005026] N88-17992
Instabilities and chaos in a multimode, standing-wave, CW dye laser
[DE88-005028] N88-17993
ROCKEFELLER UNIV., NEW YORK.
Status of the electroweak theory
[DE88-002342] N88-18494
ROCKWELL INTERNATIONAL CORP., ANAHEIM, CALIF.
Electrochromic cells with lutetium diphthalocyanine and semisolid polymer electrolytes
[AD-A188031] N88-18078
ROCKWELL INTERNATIONAL CORP., CANOGA PARK, CALIF.
International cooperative effort to establish ASTM (American Society for Testing and Materials) standards for the measurement of radiation dose for food processing
[DE88-002702] N88-18190
ROLLS-ROYCE LTD., BRISTOL (ENGLAND).
Optimisation of military compressors for weight and volume N88-17649
Advanced techniques employed in blade cooling research N88-17659
Development of a plenum chamber burner system for an advanced VTOL engine N88-17684
ROYAL AIRCRAFT ESTABLISHMENT, FARNBOROUGH (ENGLAND).
An examination of the impact of potential advances in component technology for future military engines N88-17650
Design and test of a high blade speed, high work capacity transonic turbine N88-17658
ROYAL INST. OF TECH., STOCKHOLM (SWEDEN).
On the role of the ionization frequency to gyrofrequency ratio in the critical ionization velocity interaction
[TRITA-EPP-86-10] N88-18414
RUTGERS - THE STATE UNIV., NEW BRUNSWICK, N. J.
Periodic natural convection in a rectangular enclosure of low aspect ratio N88-17941
Resonance, information, and the primacy of process: Ancient light on modern information and communication theory and technology N88-18506

S

SAINT MARY'S COLL., NOTRE DAME, IND.
Laser investigations for payload G-652 prior to filing pre-flight accommodation requirements N88-17694
SALFORD UNIV. (ENGLAND).
ESL batteries and multi-segment applications
[CS-1029/00-QFIN4] N88-17901
SAN DIEGO STATE UNIV., CALIF.
Signal processing studies program optical signal amplification, volume 2
[AD-A188054] N88-17896
Signal processing studies program optical signal amplification, volume 1
[AD-A188055] N88-17897
Signal processing studies program VLSI designs for unary functions
[AD-A188053] N88-17922
SAN JOSE STATE UNIV., CALIF.
Materials processing in space: An introduction to the G-480 payload N88-17695
SANDIA NATIONAL LABS., ALBUQUERQUE, N. MEX.
An adaptive filtering technique for removing periodic noise from modal response data
[DE88-002347] N88-17903
A technique for low level, wide range CW microwave power meter calibrations
[DE88-004147] N88-17966
Strategic placement of accelerometers to measure forces by the sum of weighted accelerations
[DE88-002262] N88-17968
Modern pulsed wavemeters
[DE88-003875] N88-17978
Flaw identification from forced vibration testing
[DE88-002641] N88-18018
Qualification of frequency response functions using the rigid-body response
[DE88-000745] N88-18033
Frequency response function estimation at level
[DE88-002644] N88-18034
Fatigue crack growth due to random loading
[DE88-004641] N88-18038
Modal testing the EOLE
[DE88-003795] N88-18066
Modal testing of a very flexible 110 m wind turbine structure
[DE88-003796] N88-18072
Analysis of wind turbines on offshore support structures excited by random wind and random waves
[DE88-004772] N88-18074
CUEMAP: A tool for generating hierarchical charts and dataflow diagrams
[DE88-004778] N88-18284
A component synthesis method using Lanczos vectors
[DE88-002263] N88-18368
High temperature processing of superconducting Y1Ba2Cu3O6.9
[DE88-003002] N88-18449
Effects of X irradiation and high field electron injection on the electrical properties of rapid thermal oxides
[DE88-002642] N88-18461
Growth and electronic properties of strained metal overlayers
[DE87-010956] N88-18463
Optical characterization of GaAs/sub 1-x/Sb/sub x/ and GaAs/sub 1-x/Sb/sub x/GaAs strained layer superlattices
[DE88-003393] N88-18464
Improved magnetization for YBa2Cu3O/sub 7-delta annealed in oxygen above 1000 C
[DE88-003934] N88-18469
Stability diagrams for epitaxial strained layers
[DE88-003935] N88-18470
Freestanding films of YBa2Cu3O/sub 6.9/
[DE88-003995] N88-18471
Order-disorder transition of Au and Pt (110) surfaces: The significance of relaxations and vibrations
[DE88-004651] N88-18473
Innovation and creativity: A critical linkage
[DE88-003309] N88-18515
SARATOV UNIV. (USSR).
Explicit solutions of moment problems, 1
[AD-A186018] N88-18325
SCIENCE APPLICATIONS INTERNATIONAL CORP., LA JOLLA, CALIF.
Fully Lagrangian Renormalized Approximation theory of fluid turbulence
[DE88-004960] N88-17952
SCIENCE APPLICATIONS INTERNATIONAL CORP., PRINCETON, N.J.
Wall jet analysis for circulation control aerodynamics. Part 1: Fundamental CFD and turbulence modeling concepts N88-17588
SCIENCE RESEARCH COUNCIL, CHILTON (ENGLAND).
Study on long term evolution towards European manned space flight. Volume 1: Executive summary
[MBB-RA3-004/87-VOL-1] N88-17689
SHAWINIGAN ENGINEERING CORP., MONTREAL (QUEBEC).
Modal testing the EOLE
[DE88-003795] N88-18066
Modal testing of a very flexible 110 m wind turbine structure
[DE88-003796] N88-18072
SIEMENS MEDICAL SYSTEMS, SAINT LOUIS, MO.
NMR (Nuclear Magnetic Resonance) imaging for detecting binder/plasticizers in green-state structural ceramics
[DE88-003111] N88-17800
SIKORSKY AIRCRAFT, STRATFORD, CONN.
The impact of circulation control on rotary aircraft controls systems N88-17601
Prediction of aeroelastic response of a model X-wing rotor N88-17603
X-wing potential for Navy applications N88-17604
SKIDAWAY INST. OF OCEANOGRAPHY, SAVANNAH, GA.
Trace element geochemistry of the South Atlantic Bight
[DE88-003515] N88-18108
Coordination: Southeast continental shelf studies
[DE88-003680] N88-18110
SOCIETE BERTIN ET CIE, PLAISIR (FRANCE).
Analysis of the performance of an air-water heat pump: Regulation of intrinsic performances
[DE88-900241] N88-18061
SOCIETE NATIONALE D'ETUDES ET DE CONSTRUCTION DE MOTEURS D'AVIATION, MOISSY-CRAMAYEL (FRANCE).
Specification of an engine and its components starting from a consideration of aircraft missions N88-17651
Design and testing of a front stage for an advanced high pressure compressor N88-17679
Computation of secondary flows in an axial multistage compressor N88-17681
SOCIETE TURBOMECA, BORDES (FRANCE).
The advantage of variable geometry for turbine engines at low power N88-17653
SOUTH CAROLINA UNIV., COLUMBIA.
A rule-based Lisp dialect translator using paramodulation N88-18238
A generalized quantile estimator under censoring
[AD-A188280] N88-18364
SOUTHERN METHODIST UNIV., DALLAS, TEX.
The precision of limits on bodily fluids when using beta-expectation inner tolerance limits
[AD-A187966] N88-18185
A VLSI implementable block oriented data driven multiprocessor N88-18249

STANFORD LINEAR ACCELERATOR CENTER, CALIF.
The numerical simulation of accelerator components
[DE87-011597] N88-18423
STANFORD UNIV., CALIF.
Control of vortical separation on conical bodies N88-17580
A theory for turbulent curved wall jets N88-17590
The further development of circulation control airfoils N88-17594
Frequency-response identification of XV-15 tilt-rotor aircraft dynamics N88-17643
Cryogenic acoustic microscopy
[AD-A187274] N88-17767
Latent failures and coverage in fault-tolerant systems. A VLSI CMOS circuit design technique to aid test generation
[AD-A187615] N88-17921
A computational study of thrust augmenting ejectors based on a viscous-inviscid approach N88-17929
Digital imaging techniques for single- and multi-phase reacting flowfields N88-17933
An experimental investigation of pressure driven three-dimensional turbulent boundary layers N88-17934
On some asymptotics of laminar flow in a coiled pipe N88-17936
Instability and transition in curved channel flow N88-17938
An integrated pressure sensor for in-vivo use N88-17965
Research studies on extreme ultraviolet and soft X-ray lasers
[AD-A187506] N88-17996
Application of nondestructive testing techniques to materials testing
[AD-A187645] N88-18021
Dynamic response of some structural elements fabricated from a non-linear elastic material N88-18031
Energy transfer and photochemistry in biomimetic solar conversion
[PB88-130026] N88-18057
Simulation and modeling of whistler mode wave growth through cyclotron resonance with energetic electrons in the magnetosphere N88-18089
Why reusable software isn't N88-18212
A strategy for failure prediction N88-18243
Eliminating columns in the simplex method for linear programming
[DE88-004191] N88-18277
Knowledge base refinement by monitoring abstract control knowledge, revision 1
[AD-A187502] N88-18323
Asymptotic expansions for large deviation probabilities in the strong law of large numbers
[AD-A187432] N88-18361
The convergence rate for the strong law of large numbers: General lattice distributions
[AD-A187560] N88-18362
Schwarz splitting and template operators
[AD-A187956] N88-18370
Specific heat of novel thin-film material systems N88-18446
Tight binding theory of semiconductors N88-18447
Exponential lower bounds for finding Brouwer fixed points
[DE88-002864] N88-18513
STATE UNIV. OF NEW YORK, ALBANY.
Light absorption by an atom moving inside a spherical box
[AD-A187241] N88-18395
STATE UNIV. OF NEW YORK, STONY BROOK.
Distributed control of large parallel computers N88-18215
Grain boundaries, planar defects and superconducting properties of YBa2Cu3O7
[DE88-003477] N88-18475
STRATEGIC AIR COMMAND, OFFUTT AFB, NEBR.
Air Force geographic information and analysis system
[DE88-001420] N88-18505
STUTTGART UNIV. (WEST GERMANY).
The unsteady gas flow through stator and rotor of a turbomachine N88-17660
Transonic blade design on rotational stream surfaces N88-17671
SUNDSTRAND DATA CONTROL, INC., REDMOND, WASH.
Windshear detection effect of static air temperature bias N88-17621
SUPERCOMPUTING RESEARCH CENTER, LANHAM, MD.
The arithmetic cube and its associated algorithms N88-18195
SUPERCON, INC., SHREWSBURY, MASS.
The effect of magnetic impurities and barriers on the magnetization and critical current of fine filament NbTi composites
[DE88-004443] N88-18472
SVERDRUP TECHNOLOGY, INC., CLEVELAND, OHIO.
Component data base for space station resistojet auxiliary propulsion
[NASA-CR-180834] N88-17731
SWEDISH SPACE CORP., STOCKHOLM.
An advanced microcomputer design for processing of semiconductor materials N88-17703
SYRACUSE UNIV., N. Y.
Wake interaction effects on the transition process on turbine blades
[AD-A188020] N88-17962
Photochemical solar energy conversion utilizing semiconductors localized in membrane mimetic systems
[DE88-002887] N88-18085
Comprehensive analysis of helicopters with bearingless rotors
[NASA-CR-182537] N88-18300
SYSTEMS APPLICATIONS, INC., SAN RAFAEL, CALIF.
Tropospheric ultraviolet radiation: Assessment of existing data and effect on ozone formation
[PB88-130133] N88-18095

T

TECHNICAL UNIV. OF ISTANBUL (TURKEY).
Recent progress in the dynamic applications of piezoelectric crystals N88-18460
TECHNISCHE HOCHSCHULE, AACHEN (WEST GERMANY).
Application of highly loaded single-stage mixed-flow compressors in small jet-engines N88-17652
TECHNISCHE HOGESCHOOL, DELFT (NETHERLANDS).
Radar reflectivity and attenuation of radio waves in the melting layer of precipitation
[PB88-121553] N88-17882
Time-domain reciprocity theorems for electromagnetic fields in dispersive media
[PB88-126925] N88-17886
Direct scattering of electromagnetic waves by one- and two-dimensional objects and its use for inverse profiling
[PB88-126909] N88-17887
Boundary-integral-equation method for computing the three-dimensional flow of groundwater
[PB88-126891] N88-17951
Performance studies of a parallel processor for large linear programming problems
[PB88-121611] N88-18310
Conjugate gradient spectral iterative technique
[PB88-126917] N88-18337
Spectral iterative technique with Gram-Schmidt orthoganalization
[PB88-127451] N88-18338
Scattering of impulsive acoustic waves by a semi-infinite crack in the plane interface of a half-space and a layer
[PB88-126396] N88-18377
TECHNISCHE HOGESCHOOL TWENTE, ENSCHEDE (NETHERLANDS).
Interactions of cultured human endothelial cells with polymeric surfaces
[PB88-112255] N88-18178
TECHNISCHE UNIV., HANOVER (WEST GERMANY).
Possibilities for on-line surge suppression by fast guide vane adjustment in axial compressors N88-17674
TECHNISCHE UNIV., MUNICH (WEST GERMANY).
Design of a charge sensitive preamplifier on high resistivity silicon
[DE88-003491] N88-17907
TEMPLE UNIV., PHILADELPHIA, PA.
Experimenting with parallel programing in logic N88-18240
TENNESSEE UNIV., KNOXVILLE.
Investigation of non-symmetric jets in cross flow N88-17932
TEXAS A&M UNIV., COLLEGE STATION.
Spatial pressure variations and three-dimensional effects on liquid sloshing loads
[PB88-120134] N88-17926
TEXAS INSTRUMENTS, INC., DALLAS.
Image texture classification with an optical crossbar interconnected processor N88-18202
TEXAS UNIV., AUSTIN.
Kinetic studies following state-selective laser excitation
[DE88-004094] N88-17981
Parallel architectures for logic programming N88-18241
Research in experimental nuclear physics
[DE88-004100] N88-18397
Study of resistive pressure-gradient-driven turbulence
[DE88-005062] N88-18441
The electronic structure of YBa2Cu3O/sub 7-delta/ above and below T/sub c/
[DE88-003495] N88-18479
TEXAS UNIV., DALLAS.
Investigation of real-time two-dimensional visualization of fuel spray liquid/vapor distribution via exciplex fluorescence
[AD-A188268] N88-17816
TEXAS UNIV., HOUSTON.
Analysis and synthesis of adaptive neural elements
[AD-A187047] N88-18316
TEXAS UNIV. AT DALLAS, RICHARDSON.
Parallels between control PDE's (Partial Differential Equations) and systems of ODE's (Ordinary Differential Equations)
[NASA-CR-182487] N88-18331
TILBURG UNIV. (NETHERLANDS).
Continuous deformation algorithm on the product space of unit simplices, revised version
[PB88-114210] N88-18281
TOHOKU UNIV., SENDAI (JAPAN).
Application of Hoffman modulation contrast microscopy coupled with three-wavelength two-beam interferometry to the in situ direct observation of the growth process of a crystal in microgravity N88-17704
TOLEDO UNIV., OHIO.
Numerical simulation of axisymmetric turbulent flow in combustors and diffusors
[NASA-CR-4115] N88-17582
Semiempirical studies of atomic structure
[DE88-004096] N88-18392
A spherical, non-LTE, blanketed model stellar atmosphere for Phi Cas (FOIa) N88-18528
TRW, INC., REDONDO BEACH, CALIF.
Physics modeling support contract
[DE88-004039] N88-17980
TURBULENCE PREDICTION SYSTEMS, BOULDER, COLO.
Infrared low-level wind shear work N88-17628

U

UNITED KINGDOM ATOMIC ENERGY AUTHORITY, HARWELL (ENGLAND).
Cost 501 Project UK10 part 3: Thermal fatigue damage of Fecralloy steel-sprayed and co-extruded tubing
[AERE-R-12230] N88-18026
UNITED TECHNOLOGIES RESEARCH CENTER, EAST HARTFORD, CONN.
Investigation of real-time two-dimensional visualization of fuel spray liquid/vapor distribution via exciplex fluorescence
[AD-A188268] N88-17816
UNIVERSIDAD NACIONAL AUTONOMA DE MEXICO, MEXICO CITY.
Microgravity research at the University of Mexico: Experiments in payload G-006 N88-17692
UNIVERSITY OF NORTHERN ILLINOIS, DE KALB.
Superconducting and magnetic properties of Fe-doped oxide superconductors
[DE88-003024] N88-18451
UNIVERSITY OF SOUTH FLORIDA, TAMPA.
Self-pumped phase conjugation in a supersonically flowing medium
[AD-A188281] N88-17998
UNIVERSITY OF SOUTHERN CALIFORNIA, LOS ANGELES.
Product kinetic and internal energy distributions via velocity-aligned Doppler spectroscopy
[DE88-003510] N88-17764
UNIVERSITY OF SOUTHWESTERN LOUISIANA, LAFAYETTE.
Multiple-bus interconnection for future multiprocessor systems N88-18203
UTAH UNIV., SALT LAKE CITY.
Fabrication, phase transformation studies and characterization of SiC-AlN-Al2OC ceramics
[DE88-004053] N88-17807
Three-dimensional transient electromagnetic modeling for exploration geophysics N88-18047
Parameterization of radiative transfer in the Earth's atmosphere with specific applications to clouds N88-18087
Implementing logical variables on a graph reduction architecture N88-18252
Computer aided geometric design
[AD-A187324] N88-18293

V

VANDERBILT UNIV., NASHVILLE, TENN.
Theoretical studies of atomic transitions
[DE88-004719] N88-18389
Non-proprietary research projects of the Center for the Space Processing of Engineering Materials
[AR-2] N88-18516

VEXCELL CORP., BOULDER, COLO.
A smart, mapping, charting and geodesy control generator, phase 1
[AD-A188184] N88-18055
VIBRATION INST., CLARENDON HILLS, ILL.
The Shock and Vibration Digest, volume 20, no. 2
N88-18459
VIRGINIA POLYTECHNIC INST. AND STATE UNIV., BLACKSBURG.
Sensitivity of active vibration control to structural changes and model reduction N88-17683
Composite materials for rail transit systems
[NASA-CR-178401] N88-17738
A finite element analysis of adhesively bonded composite joints including geometric nonlinearity, nonlinear viscoelasticity moisture diffusion and delayed failure
[AD-A187455] N88-17747
The magic of carrier patterns in moire interferometry
[AD-A187582] N88-17748
Time-resolved heat transfer measurements and analysis in the wage region of a cylinder in crossflow
N88-17939
Optimum design of geodesically stiffened composite plates
[NASA-CR-182499] N88-18035
The analysis of deformations and strains in composites by moire interferometry
[AD-A187482] N88-18043
Automatically reconfigurable computer architecture
N88-18204
Time delays and boundary feedback stabilization in one-dimensional viscoelasticity, appendices A through H
[AD-A187534] N88-18353
Well-posedness and spectral estimation for infinite dimensional systems
[AD-A187621] N88-18354
Applied mathematics of transport theory
[DE88-004098] N88-18369
VIRGINIA UNIV., CHARLOTTESVILLE.
Environment assisted degradation mechanisms in aluminum-lithium alloys
[NASA-CR-182482] N88-17782
An empirical analysis of the Lilith instruction set
N88-18193
A queueing system with independent Markov input streams
[AD-A187601] N88-18363
VON KARMAN INST. FOR FLUID DYNAMICS, RHODE-SAINT-GENESE (BELGIUM).
Investigation of dihedral effects in compressor cascades N88-17672
Velocity measurements in a 3D (three dimensional) shock wave laminar boundary layer interaction
[AD-A187334] N88-17959
VRIJE UNIVERSITEIT, AMSTERDAM (NETHERLANDS).
Strongly sequential term rewriting systems
[PB88-126693] N88-18334
Vector bundles over real algebraic varieties
[PB88-126677] N88-18335
Straightening and the Stanley decomposition for the (2;n)-nilpotent vectorfield
[PB88-126685] N88-18336
Computation of the zeta-function of an algebraic curve with the differentials of the first kind
[PB88-127527] N88-18339

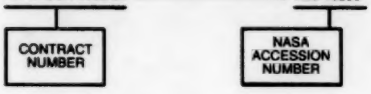
W

WASHINGTON STATE UNIV., PULLMAN.
Multi-processor reduction machines N88-18253
WASHINGTON UNIV., SEATTLE.
Explicit approximations for strictly nonlinear oscillators with slowly varying parameters with applications to free electron lasers
[DE88-004116] N88-17984
Evaluation of surface energy and radiation balance systems on the Konza Prairie
[NASA-CR-182534] N88-18097
Superfluid turbulence in He II at elevated pressures
N88-18493
An overview of the transactional interpretation of quantum mechanics
[DE88-004236] N88-18497
Velocity reversal and the arrows of time
[DE88-004237] N88-18536
WEST VIRGINIA UNIV., MORGANTOWN.
Circulation control STOL aircraft design aspects
N88-17610
WICHITA STATE UNIV., KANS.
Dynamic processor self-scheduling for general parallel nested loops
[DE88-003572] N88-18311
Deadlock prevention in processor self-scheduling for parallel nested loops
[DE88-003573] N88-18313
WINDFARMS NORTHWEST, OREG.
Cape Blanco wind farm feasibility study
[DE88-003748] N88-18059
WISCONSIN UNIV., MADISON.
Physiological and ecological implications of coupled heat- and water-transport mechanisms of endotherms and vegetation
[DE88-004170] N88-18081
Minimum Energy Routing through Interactive Techniques (MERIT) modeling
[NASA-CR-182535] N88-18105
On the dynamic estimation of relative weights for observation and forecast in numerical weather prediction
[NASA-CR-182531] N88-18106
Stability of an RFP (Reversed-Field Pinch) with resistive and distant boundaries
[DE88-004155] N88-18431
WOODS HOLE OCEANOGRAPHIC INSTITUTION, MASS.
Data-base of Antarctic pre-Pleistocene sediment cores
[PB88-124151] N88-18094
WORCESTER POLYTECHNIC INST., MASS.
An update to the MITRE/WPI Space Shuttle Program GASCAN G-408 N88-17897
Effects of ion implantation on cavitation erosion of a cobalt based metal/carbide alloy
[AD-A187239] N88-17793
Real time artificial intelligence architecture
N88-18242

Y

YALE UNIV., NEW HAVEN, CONN.
Application of satellite data in observational and theoretical studies of the evolving structure of baroclinic waves
[NASA-CR-179277] N88-18091

Typical Contract Number Index Listing



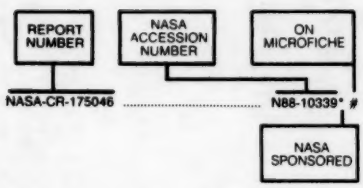
Listings in this index are arranged alphanumerically by contract number. Under each contract number the NASA accession numbers denoting documents that have been produced as a result of research done under that contract are arranged in ascending order. The NASA accession number denotes the number by which the citation is identified.

AF AFOSR-85-0211 ..... N88-18305
AF AFOSR-0063-84 ..... N88-18021
AF AFOSR-0073-87 ..... N88-17915
N88-18011
N88-18012
N88-18042
N88-18321
N88-18324
N88-18351
N88-18352
N88-18355
N88-18521
AF AFOSR-0082-86 ..... N88-17957
AF AFOSR-0085-86 ..... N88-18353
AF AFOSR-0095-87 ..... N88-18363
AF AFOSR-0144-84 ..... N88-18411
AF AFOSR-0162-86 ..... N88-18025
AF AFOSR-0168-85 ..... N88-17767
AF AFOSR-0187-82 ..... N88-18350
AF AFOSR-0189-85 ..... N88-18332
AF AFOSR-0191-86 ..... N88-17714
AF AFOSR-0202-86 ..... N88-18357
AF AFOSR-0217-86 ..... N88-17972
AF AFOSR-0226-84 ..... N88-17998
AF AFOSR-0227-85 ..... N88-18360
AF AFOSR-0238-84 ..... N88-17995
AF AFOSR-0248-86 ..... N88-17960
AF AFOSR-0258-82 ..... N88-18358
AF AFOSR-0273-83 ..... N88-17959
AF AFOSR-0295-85 ..... N88-17962
AF AFOSR-0326-84 ..... N88-18354
AF AFOSR-0347-84 ..... N88-18489
AF AFOSR-0361-84 ..... N88-17914
AF AFOSR-0376-85 ..... N88-17923
AF AFOSR-0388-84 ..... N88-18485
AF-AFOSR-85-0211 ..... N88-18328
N88-18456
AF-AFOSR-0156-84 ..... N88-18364
AF-AFOSR-0198-86 ..... N88-18009
AF-AFOSR-0213-84 ..... N88-18316
AF-AFOSR-0366-84 ..... N88-17746
ARPA ORDER 5526 ..... N88-17795
ARPA ORDER 5794 ..... N88-18268
DA PROJ. 1L1-62716-AH-70 ..... N88-17641
DA PROJ. 3E1-62777-A-878 ..... N88-18184
DAAG29-81-D-0100 ..... N88-17956
N88-18191
DAAG29-82-F-0102 ..... N88-18204
DAAG29-82-K-105 ..... N88-18243
DAAG29-83-K-0126 ..... N88-18195
DAAG29-84-C-0010 ..... N88-17816
DAAG29-84-G-0034 ..... N88-18349
DAAG29-84-K-0005 ..... N88-18358
DAAG29-84-K-0060 ..... N88-18241
DAAG29-84-K-0070 ..... N88-18226
DAAG29-85-C-0018 ..... N88-18271
DAAJ09-84-M-0706 ..... N88-17642
DAAK11-85-C-0031 ..... N88-17641
DAAL03-86-K-0022 ..... N88-18052
DACA72-86-C-0008 ..... N88-18055
DACA76-84-C-0004 ..... N88-17640
DACA76-85-C-0100 ..... N88-18410
DAMD17-85-C-5238 ..... N88-18184
DE-AC02-76CH-00016 ..... N88-17773
N88-17787
N88-17809
N88-17907
N88-17969
N88-17990
N88-17991
N88-18318
N88-18319
N88-18465
N88-18472
N88-18475
N88-18476
N88-18477
N88-18478
N88-18479
N88-18484
N88-18508
N88-18533
DE-AC02-76CH-03000 ..... N88-18496
N88-18517
N88-18531
N88-18532
N88-18534
N88-18535
DE-AC02-78ER-04971 ..... N88-18386
DE-AC02-82ER-12037 ..... N88-17806
DE-AC02-83CH-10093 ..... N88-18063
N88-18069
N88-18070
N88-18075
DE-AC02-87ER-40325 ..... N88-18494
DE-AC03-76SF-00098 ..... N88-17888
N88-17889
N88-17912
N88-18082
N88-18121
N88-18467
N88-18468
N88-18480
N88-18483
N88-18501
N88-18517
DE-AC03-76SF-00515 ..... N88-18423
DE-AC03-83SF-11903 ..... N88-18190
DE-AC03-84ER-13174 ..... N88-17952
DE-AC03-85ER-40050 ..... N88-18263
DE-AC04-76DP-00053 ..... N88-17792
N88-18006
DE-AC04-76DP-00613 ..... N88-17902
DE-AC04-76DP-00789 ..... N88-17903
N88-17927
N88-17966
N88-17968
N88-17978
N88-18018
N88-18033
N88-18034
N88-18038
N88-18066
N88-18072
N88-18074
N88-18284
N88-18368
N88-18449
N88-18461
N88-18463
N88-18464
N88-18469
N88-18470
N88-18471
N88-18515
DE-AC04-76DR-00789 ..... N88-18473
DE-AC04-86AL-33183 ..... N88-17948
DE-AC05-76OR-00033 ..... N88-17765
DE-AC05-84OR-21400 ..... N88-17790
N88-17804
N88-17818
N88-17883
N88-17911
N88-17949
N88-17994
N88-18173
N88-18327
N88-18384
N88-18388
N88-18391
N88-18394
N88-18406
N88-18407
N88-18424
N88-18428
N88-18436
N88-18438
N88-18439
N88-18440
N88-18441
N88-18465
N88-18505
N88-18510
DE-AC05-84OT-21400 ..... N88-17667
N88-18509
DE-AC06-76RL-01830 ..... N88-17785
N88-17786
N88-17945
N88-18071
N88-18080
N88-18385
DE-AC06-81ER-40048 ..... N88-18497
N88-18536
DE-AC06-87RL-10930 ..... N88-18504
DE-AC08-87DP-10560 ..... N88-18429
DE-AC09-76SR-00001 ..... N88-17789
N88-18264
DE-AC21-84MC-21181 ..... N88-18048
N88-18050
DE-AC21-86MC-23264 ..... N88-18058
DE-AC22-76ET-10532 ..... N88-17813
DE-AC79-83BP-11191 ..... N88-18059
N88-18060
DE-AI05-86ER-25016 ..... N88-17984
DE-AS05-80ER-10618 ..... N88-18389
DE-AS05-80ER-10676 ..... N88-18392
DE-AS05-81ER-40032 ..... N88-18390
DE-AS05-83ER-13142 ..... N88-18001
DE-FG01-82ER-12018 ..... N88-17761
DE-FG02-84ER-45092 ..... N88-17806
DE-FG02-84ER-60264 ..... N88-18081
DE-FG02-85ER-13331 ..... N88-18504
DE-FG02-85ER-25001 ..... N88-18260
N88-18261
N88-18274
N88-18275
N88-18276
N88-18282
N88-18288
N88-18304
N88-18305
N88-18306
N88-18307
N88-18308
N88-18309
N88-18311
N88-18313
N88-18314
N88-18317
N88-18328
N88-18340
N88-18456
N88-18466
DE-FG02-85ER-45190 ..... N88-18499
DE-FG02-85ER-45205 ..... N88-17788
DE-FG02-85ER-53212 ..... N88-18431
DE-FG02-86ER-13488 ..... N88-18500
DE-FG02-86ER-13501 ..... N88-18393
DE-FG02-86ER-13506 ..... N88-18065
DE-FG02-86ER-13515 ..... N88-18382
DE-FG02-86ER-45258 ..... N88-18378
DE-FG02-86ER-60418 ..... N88-18017
DE-FG02-87ER-13761 ..... N88-17992
N88-17993
DE-FG02-87ER-25026 ..... N88-18342
DE-FG02-87ER-45286 ..... N88-17807
DE-FG02-87ER-45294 ..... N88-18481

DE-FG02-87ER-45308 ..... N88-17791
DE-FG02-87ER-53252 ..... N88-18442
DE-FG03-85ER-13363 ..... N88-17764
DE-FG03-85ER-25009 ..... N88-18262
N88-18263
DE-FG03-86ER-13521 ..... N88-18383
DE-FG03-86ER-53220 ..... N88-18381
N88-18437
DE-FG03-87ER-25028 ..... N88-18277
DE-FG05-84ER-13191 ..... N88-17981
DE-FG05-84ER-13213 ..... N88-17989
DE-FG05-85ER-40219 ..... N88-18502
DE-FG05-87ER-13678 ..... N88-17763
DE-FG05-87ER-25033 ..... N88-18369
DE-FG05-87ER-40343 ..... N88-18397
DE-FG06-86ER-13530 ..... N88-18096
DE-FG06-86ER-45273 ..... N88-17976
DE-FG07-83ID-12380 ..... N88-17906
DE-FG09-86ER-60435 ..... N88-18108
DE-FG09-86ER-60450 ..... N88-18110
DE-FG22-83PC-60800 ..... N88-17760
DE-FG22-85PC-80503 ..... N88-18474
DE-FG22-86PC-90959 ..... N88-18375
DI-14-08-0001-G-1124 ..... N88-17761
DNA001-83-C-0182 ..... N88-17654
DTFA01-86-C-00005 ..... N88-17637
DTMA91-85-C-50120 ..... N88-17926
EPA-68-02-4127 ..... N88-17759
EPRQ PROJ. 1630-40 ..... N88-18080
ESA-6361/85-NL-PP(SC) N88-17690
ESA-6466/85-NL-MA N88-17901
ESA-6492/85-NL-AN(SC) N88-17719
ESA-6669/86-NL-PP(SC) N88-17689
ESE-R-037-F N88-18120
F2901-84-C-0080 ..... N88-17871
F19628-83-K-0035 ..... N88-18098
F19628-85-C-0002 ..... N88-18360
F19628-85-C-0003 ..... N88-18290
N88-18291
F19628-86-K-0006 ..... N88-18054
F30602-83-K-0119 ..... N88-18209
F33615-83-K-0038 ..... N88-18188
F33615-85-C-5015 ..... N88-18013
F49620-84-C-0055 ..... N88-17749
F49620-84-C-0060 ..... N88-18444
F49620-85-C-0101 ..... N88-17998
F49620-85-C-0108 ..... N88-17958
F49620-85-C-0129 ..... N88-17795
F49620-85-C-0144 ..... N88-18325
N88-18371
F49620-86-C-0082 ..... N88-18268
F49620-86-C-0094 ..... N88-17961
F49620-86-K-0005 ..... N88-18209
F49620-87-C-0021 ..... N88-18486
GRI-5081-360-0533 ..... N88-18093
GRI-5083-260-0824 ..... N88-18057
GRI-5085-260-1152 ..... N88-17805
MDA-53-10844630 ..... N88-17610
MDA903-83-C-0335 ..... N88-17921
MDA903-86-C-0345 ..... N88-18298
MDA903-86-K-0220 ..... N88-17802
MDA904-85-5027 ..... N88-18209
MDA904-86-14-0003 ..... N88-18225
MIPR-ARO-109-87 ..... N88-17996
MIPR-ARO-139-85 ..... N88-18364
NAGW-581 ..... N88-17583
NAG1-56 ..... N88-18376
NAG1-163 ..... N88-18312
NAG1-430 ..... N88-18206
NAG1-517 ..... N88-18346
NAG1-592 ..... N88-18105
NAG1-613 ..... N88-18210
N88-18267
N88-18289
NAG1-635 ..... N88-17612
NAG1-643 ..... N88-18035
NAG1-673 ..... N88-17738
NAG1-745 ..... N88-17782
NAG1-759 ..... N88-18300
NAG2-366 ..... N88-18331
NAG3-355 ..... N88-17582
NAG3-392 ..... N88-17892
NAG5-315 ..... N88-18106
NAG5-521 ..... N88-18097
NAG5-836 ..... N88-18259
NAG8-058 ..... N88-18427
NAG8-480 ..... N88-17784
NAG8-629 ..... N88-17733
NASW-3511 ..... N88-17727
NASW-3966 ..... N88-18540
NASW-4292 ..... N88-18175
NASW-4307 ..... N88-17803
N88-18181
N88-18182
N88-18462
NAS1-18107 ..... N88-17684
N88-17955
N88-18272
N88-18279
N88-18299
N88-18301
N88-18332
N88-18345
N88-18348
N88-18022
NAS2-11853 ..... N88-17585
NAS2-11912 ..... N88-17720
NAS2-12051 ..... N88-17731
NAS3-24105 ..... N88-17702
NAS3-24644 ..... N88-18068
NAS3-24670 ..... N88-17732
NAS3-24842 ..... N88-17964
NAS5-29276 ..... N88-18398
NAS5-29284 ..... N88-17890
NAS7-918 ..... N88-17891
N88-18008
N88-18083
N88-18523
N88-18524
N88-18538
NAS8-31088 ..... N88-18427
NAS8-34903 ..... N88-18091
NAS8-35471 ..... N88-17721
N88-17722
N88-17723
N88-17724
NAS8-35614 ..... N88-17716
N88-17717
NAS8-36426 ..... N88-17688
NAS10-10285 ..... N88-18148
N88-18177
NCA2-40 ..... N88-17587
NCC3-30 ..... N88-17954
NGT-05-010-804 ..... N88-18049
NSF ATM-84-0373 ..... N88-18106
NSF CDR-85-00108 ..... N88-17915
N88-18321
NSF DCR-82-00129 ..... N88-17921
NSF DCR-82-02591 ..... N88-18198
NSF DCR-83-16590 ..... N88-18206
NSF DCR-84-05241 ..... N88-18251
NSF DCR-84-06916 ..... N88-18456
NSF DCR-84-10110 ..... N88-18260
N88-18261
N88-18304
N88-18305
N88-18328
N88-18456
NSF DCR-85-00970 ..... N88-18456
NSF DCR-85-06000 ..... N88-18252
NSF DCR-85-09770 ..... N88-18328
NSF DCR-85-09970 ..... N88-18305
NSF DCR-85-11436 ..... N88-18217
NSF DCR-86-03609 ..... N88-18297
NSF DCR-86-03722 ..... N88-18328
NSF DMS-85-00947 ..... N88-18353
NSF DMS-85-16191 ..... N88-18356
NSF DMS-86-02672 ..... N88-18335
NSF DMS85-16191 ..... N88-18348
NSF DPP83-17087 ..... N88-18094
NSF EAR-85-18789 ..... N88-17761
NSF ECS-82-19123 ..... N88-18351
NSF ECS-83-12921 ..... N88-18380
NSF ECS-86-96090 ..... N88-18371
NSF INT-84-93793 ..... N88-18351
NSF OCE79-19092 ..... N88-18094
NSF OIR-85-00108 ..... N88-18011
N88-18042
NSF OIT85-00108 ..... N88-18012
NSF SPE-84-70489 ..... N88-18333
N00014-77-C-0630 ..... N88-18078
N00014-82-K-0185 ..... N88-17747
N00014-82-K-0335 ..... N88-18370
N00014-82-K-0351 ..... N88-18293
N00014-82-K-0523 ..... N88-18077
N00014-82-K-0727 ..... N88-17893
N00014-83-C-0148 ..... N88-18295
N00014-83-K-0125 ..... N88-18273
N00014-83-K-0655 ..... N88-18295
N00014-83-K-0695 ..... N88-18396
N00014-83-K-0731 ..... N88-18324
N00014-84-K-0146 ..... N88-18185
N00014-84-K-0465 ..... N88-17920
N00014-84-K-0545 ..... N88-17766
N88-18487
N88-18488
N88-18490
N88-18491
N00014-85-C-0079 ..... N88-18239
N00014-85-C-0221 ..... N88-17872
N00014-85-C-0638 ..... N88-17794
N00014-85-C-0755 ..... N88-18202
N00014-85-C-2182 ..... N88-18209
N00014-85-K-0122 ..... N88-18230
N00014-85-K-0124 ..... N88-17918
N88-18322
N88-18410
N00014-85-K-0169 ..... N88-18041
N88-18347
N88-18348
N88-18356
N00014-85-K-0305 ..... N88-18323
N00014-85-K-0551 ..... N88-18328
N00014-85-K-0602 ..... N88-17900
N00014-85-K-0641 ..... N88-17810
N00014-85-K-0880 ..... N88-17797
N00014-86-F-0049 ..... N88-18544
N88-18545
N00014-86-K-0007 ..... N88-18350
N00014-86-K-0034 ..... N88-18117
N88-18118
N00014-86-K-0043 ..... N88-18395
N00014-86-K-0180 ..... N88-17918
N00014-86-K-0255 ..... N88-17748
N88-18043
N00014-86-K-0391 ..... N88-17793
N00014-86-K-0533 ..... N88-17916
N00014-86-K-0680 ..... N88-18297
N88-18315
N00014-86-K-0693 ..... N88-17684
N00014-87-G-0116 ..... N88-18112
N00014-87-K-0078 ..... N88-18361
N88-18362
N00014-87-K-0242 ..... N88-18111
N00039-84-C-0089 ..... N88-18198
N00039-87-C-5301 ..... N88-18053
N66001-85-D-0203 ..... N88-17896
N88-17897
N88-17922
N68335-84-C-1664 ..... N88-17758
N0016785-M-4484 ..... N88-17600
PROJ. F41-460 ..... N88-17758
PROJ. RR0-4206 ..... N88-18295
N88-18323
W-31-109-ENG-38 ..... N88-17750
N88-17751
N88-17752
N88-17774
N88-17799
N88-17800
N88-17928
N88-17946
N88-17947
N88-18037
N88-18064
N88-18073
N88-18287
N88-18326
N88-18329
N88-18445
N88-18448
N88-18513
W-7405-ENG-36 ..... N88-17742
N88-17766
N88-17814
N88-17908
N88-17909
N88-17953
N88-17971
N88-17974
N88-17975
N88-17983
N88-17985
N88-17986
N88-17987
N88-17988
N88-18265
N88-18266
N88-18341
N88-18359
N88-18365
N88-18372
N88-18387
N88-18404
N88-18405
N88-18408
N88-18482
N88-18498
N88-18520
N88-18537
N88-18541
N88-18543
N88-18546
W-7405-ENG-48 ..... N88-17726
N88-17888
N88-17889
N88-17970
N88-17977

	N88-17979
	N88-17980
	N88-18005
	N88-18283
	N88-18326
	N88-18402
	N88-18425
	N88-18430
	N88-18432
	N88-18433
	N88-18434
	N88-18435
	N88-18455
	N88-18517
	N88-18530
W-7405-ENG-82	N88-18476
W-31109-ENG-38	N88-17755
	N88-17781
	N88-17812
	N88-18450
	N88-18451
	N88-18452
	N88-18453
	N88-18454
	N88-18484
055-10-02	N88-18538
159-41-06	N88-17720
199-40-32	N88-18174
310-10-63-86-04	N88-18524
314-30-41-81-35	N88-18523
314-40-32	N88-18083
315-20-50	N88-17890
474-46-30	N88-17715
481-02-02	N88-17728
	N88-17731
481-50-32	N88-18058
505-43-01	N88-17585
505-60	N88-18344
505-60-21-02	N88-17614
505-61-51	N88-17646
505-61-71	N88-17581
	N88-17586
505-61-71-01	N88-17615
505-62-3A	N88-17686
505-62-21	N88-17582
505-63-1A	N88-17954
505-63-1B	N88-18007
505-63-01	N88-17796
505-63-01-05	N88-17737
505-63-01-09	N88-17739
505-63-11	N88-17744
	N88-17745
505-66-11	N88-18320
	N88-18366
505-67-41-03	N88-17616
505-67-51	N88-17645
505-90-21-01	N88-17684
	N88-17955
	N88-18272
	N88-18279
	N88-18299
	N88-18301
	N88-18332
	N88-18345
	N88-18346
505-90-21-02	N88-18302
506-41-41-02	N88-18443
506-43-11	N88-17801
506-43-31	N88-17743
506-44-2C	N88-17880
506-63-1B	N88-18040
533-51-02	N88-17644
535-03-01	N88-18036
	N88-18379
643-10-05	N88-17899

Typical Report Number Index Listing



Listings in this index are arranged alphanumerically by report number. The NASA accession number denotes the number by which the citation is identified. An asterisk (*) indicates that the item is a NASA report. A pound sign (#) indicates that the item is available on microfiche.

A-86314 ..... N88-17586* #
A-87248 ..... N88-18174* #
A-87364 ..... N88-17646* #
A-87385 ..... N88-17645* #
A-88027 ..... N88-17584* #
A-88038 ..... N88-17581* #
A-88059 ..... N88-17743* #
A-88068 ..... N88-18320* #
A-88087 ..... N88-18366* #
A-88109 ..... N88-18344* #
A-88110 ..... N88-18343* #

AAMRL-TR-87-032 ..... N88-18373 #

AD-A175903 ..... N88-17924* #
AD-A184949 ..... N88-18191 #
AD-A186018 ..... N88-18325 #
AD-A186444 ..... N88-18013 #
AD-A186554 ..... N88-17872 #
AD-A186563 ..... N88-17797 #
AD-A186576 ..... N88-17642 #
AD-A186794 ..... N88-17900 #
AD-A186853 ..... N88-18045 #
AD-A186917 ..... N88-17783 #
AD-A186922 ..... N88-18373 #
AD-A186933 ..... N88-17925 #
AD-A186943 ..... N88-17735 #
AD-A186947 ..... N88-18023 #
AD-A186950 ..... N88-18024 #
AD-A187031 ..... N88-18273 #
AD-A187047 ..... N88-18316 #
AD-A187075 ..... N88-17641 #
AD-A187080 ..... N88-18270 #
AD-A187082 ..... N88-18303 #
AD-A187083 ..... N88-18399 #
AD-A187084 ..... N88-18413 #
AD-A187120 ..... N88-18271 #
AD-A187121 ..... N88-18444 #
AD-A187123 ..... N88-18025 #
AD-A187130 ..... N88-17718 #
AD-A187131 ..... N88-17758 #
AD-A187172 ..... N88-17956 #
AD-A187179 ..... N88-17729 #
AD-A187217 ..... N88-18009 #
AD-A187221 ..... N88-17746 #
AD-A187224 ..... N88-17913 #
AD-A187226 ..... N88-17815 #
AD-A187230 ..... N88-18290 #
AD-A187231 ..... N88-18291 #
AD-A187239 ..... N88-17793 #
AD-A187241 ..... N88-18395 #
AD-A187250 ..... N88-17957 #
AD-A187254 ..... N88-18347 #
AD-A187261 ..... N88-17958 #
AD-A187262 ..... N88-17794 #
AD-A187274 ..... N88-17767 #
AD-A187276 ..... N88-18292 #
AD-A187283 ..... N88-18111 #
AD-A187287 ..... N88-18512 #
AD-A187293 ..... N88-17893 #
AD-A187319 ..... N88-18409 #
AD-A187324 ..... N88-18293 #
AD-A187334 ..... N88-17959 #
AD-A187335 ..... N88-18485 #
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AD-A187378 ..... N88-18349 #
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AD-A187397 ..... N88-18184 #
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AD-A187476 ..... N88-18322 #
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AD-A187592 ..... N88-18012 #
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AD-A187604 ..... N88-18116 #
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AD-A187630 ..... N88-18355 #
AD-A187632 ..... N88-18521 #
AD-A187642 ..... N88-17961 #
AD-A187645 ..... N88-18021 #
AD-A187840 ..... N88-18022* #
AD-A187885 ..... N88-18053 #
AD-A187888 ..... N88-18098 #
AD-A187930 ..... N88-17810 #
AD-A187954 ..... N88-17973 #
AD-A187956 ..... N88-18370 #
AD-A187966 ..... N88-18185 #
AD-A187981 ..... N88-18371 #
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AD-A187997 ..... N88-17997 #
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AD-A188179 ..... N88-18298 #
AD-A188184 ..... N88-18055 #
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AD-A188187 ..... N88-17898 #
AD-A188188 ..... N88-18186 #
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AD-A188190 ..... N88-18100 #
AD-A188264 ..... N88-18107 #
AD-A188268 ..... N88-17816 #
AD-A188278 ..... N88-18358 #
AD-A188279 ..... N88-18411 #
AD-A188280 ..... N88-18364 #
AD-A188281 ..... N88-17998 #
AD-A188282 ..... N88-17749 #
AD-A188283 ..... N88-17923 #

AERE-M-3615 ..... N88-17778 #

AERE-R-12041 ..... N88-18015 #
AERE-R-12230 ..... N88-18026 #
AERE-R-12317 ..... N88-17753 #
AERE-R-12319 ..... N88-18014 #
AERE-R-12360 ..... N88-17798 #
AERE-R-12386 ..... N88-18016 #
AERE-R-12387 ..... N88-18027 #
AERE-R-12428 ..... N88-17777 #
AERE-R-12498 ..... N88-17776 #
AERE-R-12502 ..... N88-17754 #
AERE-R-12517 ..... N88-17736 #
AERE-R-12667 ..... N88-17779 #

AFESC/ESL-TR-86-50 ..... N88-17871 #

AFGL-TR-87-0012 ..... N88-18098 #

AFHRL-TR-87-16 ..... N88-18188 #

AFIT/CI/NR-87-73T ..... N88-18292 #
AFIT/CI/NR-87-90T ..... N88-17919 #

AFIT/GLM/LSMB/87S-21 ..... N88-18296 #

AFOSR-87-1004TR ..... N88-18371 #
AFOSR-87-1146TR ..... N88-18325 #
AFOSR-87-1387TR ..... N88-17914 #
AFOSR-87-1388TR ..... N88-17959 #
AFOSR-87-1389TR ..... N88-17958 #
AFOSR-87-1393TR ..... N88-18485 #
AFOSR-87-1432TR ..... N88-18012 #
AFOSR-87-1433TR-PT-1 ..... N88-18042 #
AFOSR-87-1434TR ..... N88-18521 #
AFOSR-87-1435TR ..... N88-18011 #
AFOSR-87-1438TR ..... N88-18321 #
AFOSR-87-1439TR ..... N88-18324 #
AFOSR-87-1440TR ..... N88-18351 #
AFOSR-87-1441TR ..... N88-18355 #
AFOSR-87-1442TR ..... N88-18352 #
AFOSR-87-1443TR ..... N88-17915 #
AFOSR-87-1451TR ..... N88-17746 #
AFOSR-87-1453TR ..... N88-17957 #
AFOSR-87-1475TR ..... N88-17960 #
AFOSR-87-1561TR ..... N88-18009 #
AFOSR-87-1562TR ..... N88-18025 #
AFOSR-87-1567TR ..... N88-18316 #
AFOSR-87-1578TR ..... N88-18354 #
AFOSR-87-1580TR ..... N88-17767 #
AFOSR-87-1583TR ..... N88-17995 #

AFOSR-87-1586TR ..... N88-18489 #
AFOSR-87-1586TR ..... N88-17972 #
AFOSR-87-1604TR-APP-A-H ..... N88-18353 #
AFOSR-87-1605TR ..... N88-18380 #
AFOSR-87-1611TR ..... N88-18356 #
AFOSR-87-1616TR ..... N88-18411 #
AFOSR-87-1617TR ..... N88-18364 #
AFOSR-87-1619TR ..... N88-18363 #
AFOSR-87-1626TR ..... N88-18486 #
AFOSR-87-1632TR ..... N88-18444 #
AFOSR-87-1633TR ..... N88-17795 #
AFOSR-87-1646TR ..... N88-18268 #
AFOSR-87-1656TR ..... N88-17998 #
AFOSR-87-1658TR ..... N88-17749 #
AFOSR-87-1659TR ..... N88-17923 #
AFOSR-87-1707TR ..... N88-17714 #
AFOSR-87-1827TR ..... N88-18357 #
AFOSR-87-1915TR ..... N88-17962 #
AFOSR-87-1927TR ..... N88-18021 #
AFOSR-87-1932TR ..... N88-17961 #

AGARD-CP-421 ..... N88-17647 #

AGARD-R-735 ..... N88-17682 #

AI-MEMO-975 ..... N88-18410 #

AI-TR-963 ..... N88-18322 #
AI-TR-978 ..... N88-17918 #

AMSTE-RP-702-100 ..... N88-17783 #

ANL-87-46 ..... N88-18326 #

ANL/CNSV-TM-191 ..... N88-18073 #

ANL/MCS-TM-101 ..... N88-18329 #

AR-2 ..... N88-18516 #

ARE-TM(UMM)-87402 ..... N88-17772 #

ARL-STRUC-TM-458 ..... N88-17917 #
ARL-STRUC-TM-466 ..... N88-18024 #
ARL-STRUC-TM-469 ..... N88-18023 #
ARL-STRUC-TM-470 ..... N88-17735 #

ARO-21132.4-EG ..... N88-17816 #
ARO-21704.23-MA ..... N88-18349 #
ARO-22842.15-PH ..... N88-17996 #
ARO-23306.100-MA ..... N88-18271 #
ARO-23313.5-GS ..... N88-18052 #

AVSCOM-TR-87-A-10 ..... N88-17642 #

BBC-RD-1987/19 ..... N88-17876
BBC-RD-1987/21 ..... N88-17878
BBC-RD-1987/23 ..... N88-17877

BDI-187 ..... N88-17856 #

BDX-613-3798 ..... N88-17902 #

BN-1067 ..... N88-18347 #
BN-1068 ..... N88-18041 #
BN-1069 ..... N88-18348 #

BNL-40314 ..... N88-18318 #
BNL-40336 ..... N88-18506 #
BNL-40413 ..... N88-18533 #
BNL-40430 ..... N88-17787 #
BNL-40441 ..... N88-18479 #
BNL-40464 ..... N88-17907 #
BNL-40465 ..... N88-18475 #
BNL-40480 ..... N88-18477 #
BNL-40481 ..... N88-18476 #
BNL-40484 ..... N88-18465 #
BNL-40486 ..... N88-17989 #
BNL-40489 ..... N88-18478 #
BNL-40507 ..... N88-17990 #
BNL-40543 ..... N88-18472 #
BNL-40547 ..... N88-17809 #
BNL-40590 ..... N88-18484 #
BNL-40592 ..... N88-18319 #
BNL-40691 ..... N88-17991 #

BRL-MR-3626 ..... N88-17913 #

BRL-TR-2848 ..... N88-17956 #
BRL-TR-2850 ..... N88-17815 #

BR102091 ..... N88-17772 #

CAR-TR-285 ..... N88-17640 #

CAS/ESM-87-9 ..... N88-17747 #

CLASSIC-87-3 ..... N88-18370 #

CMU/SEI-87-TR-22 ..... N88-18291 #
CMU/SEI-87-TR-23 ..... N88-18290 #

COE-292 ..... N88-17926 #

CONF-870102-30 ..... N88-17818 #
CONF-870277-2 ..... N88-18517* #
CONF-870307-25 ..... N88-17945 #
CONF-870410-40-APP-4 ..... N88-17813 #
CONF-870438-38 ..... N88-18476 #
CONF-870466-6 ..... N88-17789 #
CONF-870658-4 ..... N88-17787 #
CONF-870659-6 ..... N88-17752 #
CONF-870666-2 ..... N88-18065 #
CONF-870701-13 ..... N88-17751 #
CONF-870796-3-APP-E2 ..... N88-17760 #
CONF-870797-8 ..... N88-18494 #
CONF-870797-12 ..... N88-18531 #
CONF-870831-5 ..... N88-18313 #
CONF-870831-6 ..... N88-18276 #
CONF-870831-7 ..... N88-18307 #
CONF-870831-8 ..... N88-18306 #
CONF-870831-10 ..... N88-18305 #
CONF-870831-11 ..... N88-18275 #
CONF-870831-14 ..... N88-18311 #
CONF-870831-15 ..... N88-18314 #
CONF-870873-21 ..... N88-18450 #
CONF-870873-22 ..... N88-18445 #
CONF-870881-6 ..... N88-18453 #
CONF-870881-8 ..... N88-18451 #
CONF-870893-6 ..... N88-17781 #
CONF-870901-23 ..... N88-18472 #
CONF-870954-1 ..... N88-18082 #
CONF-871006-20 ..... N88-17907 #
CONF-871006-21 ..... N88-17969 #
CONF-871006-32 ..... N88-17889 #
CONF-871006-33 ..... N88-17888 #
CONF-871007-78 ..... N88-18434 #
CONF-871007-82 ..... N88-17883 #
CONF-871020-6 ..... N88-18385 #
CONF-871036-29 ..... N88-17785 #
CONF-871036-31 ..... N88-17786 #
CONF-871062-10 ..... N88-18070 #
CONF-871072-1 ..... N88-17912 #
CONF-871093-1 ..... N88-17988 #
CONF-871105-4 ..... N88-18441 #
CONF-871124-16 ..... N88-18327 #
CONF-871124-17 ..... N88-18468 #
CONF-871124-21 ..... N88-18402 #
CONF-871124-22 ..... N88-18471 #
CONF-871124-24 ..... N88-18480 #
CONF-871124-30 ..... N88-18469 #
CONF-871124-31 ..... N88-18470 #
CONF-871124-44 ..... N88-18475 #
CONF-871124-48 ..... N88-18478 #
CONF-871124-56 ..... N88-18484 #
CONF-871125-16 ..... N88-18429 #
CONF-871126-9 ..... N88-18465 #
CONF-871147-2 ..... N88-18388 #
CONF-871147-6 ..... N88-18391 #
CONF-871147-8 ..... N88-17994 #
CONF-871147-9 ..... N88-17991 #
CONF-871178-2 ..... N88-18479 #
CONF-871179-2-VUGRAPHS ..... N88-18439 #
CONF-871179-3-VUGRAPHS ..... N88-18438 #
CONF-871179-9 ..... N88-18428 #
CONF-871179-10-VUGRAPHS ..... N88-18440 #
CONF-871193-1 ..... N88-17750 #
CONF-871194-1 ..... N88-18064 #
CONF-871196-1 ..... N88-17947 #
CONF-871204-2 ..... N88-18432 #
CONF-871232-2 ..... N88-17774 #
CONF-871234-2 ..... N88-17946 #
CONF-871234-4 ..... N88-17927 #
CONF-871245-1 ..... N88-18541 #
CONF-871245-2 ..... N88-18537 #
CONF-871246-1 ..... N88-18387 #
CONF-871248-1 ..... N88-18264 #
CONF-871251-1 ..... N88-18340 #
CONF-871251-2 ..... N88-18288 #
CONF-880110-1 ..... N88-17978 #
CONF-880110-2 ..... N88-18464 #
CONF-880110-8 ..... N88-17985 #
CONF-880110-12 ..... N88-17986 #
CONF-880122-5 ..... N88-17911 #
CONF-880132-4 ..... N88-18075 #
CONF-880132-5 ..... N88-18066 #
CONF-880212-3 ..... N88-18482 #
CONF-880218-1 ..... N88-18173 #
CONF-880220-1 ..... N88-19033 #
CONF-880220-3 ..... N88-18368 #
CONF-880220-4 ..... N88-17968 #
CONF-880220-5 ..... N88-17903 #
CONF-880220-6 ..... N88-18034 #

CONF-880220-7 ..... N88-18018 #
CONF-880220-9 ..... N88-18072 #
CONF-880220-13 ..... N88-17687 #
CONF-880234-1 ..... N88-18515 #
CONF-8703217-1 ..... N88-17977 #
CONF-8704231-2 ..... N88-17800 #
CONF-8704252-1 ..... N88-18483 #
CONF-8705103-13 ..... N88-18071 #
CONF-8705147-4 ..... N88-18510 #
CONF-8705223-1 ..... N88-18461 #
CONF-8705224-1 ..... N88-17928 #
CONF-8705226-1 ..... N88-18454 #
CONF-8705226-2 ..... N88-18394 #
CONF-8705243-1 ..... N88-18312* #
CONF-8706125-25 ..... N88-18477 #
CONF-8706138-2 ..... N88-18317 #
CONF-8706183-3 ..... N88-18308 #
CONF-8706237-2 ..... N88-18452 #
CONF-8706238-1 ..... N88-18423 #
CONF-8706239-1 ..... N88-18483 #
CONF-8707143-1 ..... N88-18535 #
CONF-8708110-29 ..... N88-17979 #
CONF-8708110-30 ..... N88-18433 #
CONF-8708141-6 ..... N88-18543 #
CONF-8708141-7 ..... N88-18546 #
CONF-8708145-5 ..... N88-18319 #
CONF-8708148-2 ..... N88-18287 #
CONF-8708195-1 ..... N88-18467 #
CONF-8708202-1 ..... N88-18534 #
CONF-8708202-3 ..... N88-18532 #
CONF-8709110-11 ..... N88-17974 #
CONF-8709110-13 ..... N88-17975 #
CONF-8709110-18 ..... N88-17983 #
CONF-8709110-19 ..... N88-17990 #
CONF-8709113-3 ..... N88-17755 #
CONF-8709116-6 ..... N88-17799 #
CONF-8709139-2 ..... N88-17970 #
CONF-8709140-2 ..... N88-18435 #
CONF-8709151-9 ..... N88-18318 #
CONF-8709185-1 ..... N88-17902 #
CONF-8709186-2 ..... N88-18530 #
CONF-8709186-3 ..... N88-18533 #
CONF-8709201-1 ..... N88-17812 #
CONF-8709219-1 ..... N88-18496 #
CONF-8709225-3 ..... N88-18341 #
CONF-8710111-20 ..... N88-17790 #
CONF-8710125-7 ..... N88-18496 #
CONF-8710165-5 ..... N88-18406 #
CONF-8710172-1 ..... N88-18508 #
CONF-8710173-1 ..... N88-18505 #
CONF-8710212-1-SUMM ..... N88-18513 #
CONF-8710216-2 ..... N88-18449 #
CONF-8710220-1 ..... N88-18037 #
CONF-8710229-1 ..... N88-18448 #
CONF-8710254-1 ..... N88-18405 #
CONF-8711103-1 ..... N88-18190 #
CONF-8711107-2 ..... N88-18384 #
CONF-8711107-3 ..... N88-18430 #
CONF-8711113-1 ..... N88-18455 #
CONF-8711118-1 ..... N88-17987 #
CONF-8711123-1 ..... N88-18406 #

CRC-TR-86-18 ..... N88-17921 #

CRINC-FRL-730-1 ..... N88-17612* #

CRREL-87-14 ..... N88-18119 #
CRREL-87-19 ..... N88-17925 #

CS-TR-1831 ..... N88-17640 #

CS-1029/00-QFIN4 ..... N88-17901 #
CS-8702 ..... N88-18285 #

CSG-84 ..... N88-18269* #
CSG-85 ..... N88-18267* #

CSRD-626 ..... N88-18313 #
CSRD-646 ..... N88-18328 #
CSRD-647 ..... N88-18282 #
CSRD-668 ..... N88-18304 #
CSRD-674 ..... N88-18260 #
CSRD-679 ..... N88-18261 #

DATA-137 ..... N88-18111 #

DE87-010956 ..... N88-18463 #
DE87-011597 ..... N88-18423 #
DE87-012820 ..... N88-17773 #
DE87-013639 ..... N88-18017 #
DE88-000335 ..... N88-18173 #
DE88-000348 ..... N88-18375 #
DE88-000485 ..... N88-18517* #
DE88-000745 ..... N88-18033 #
DE88-001004 ..... N88-17762 #
DE88-001007 ..... N88-18050 #

DE88-001006 ..... N88-18048 #
DE88-001015 ..... N88-18058 #
DE88-001103 ..... N88-18063 #
DE88-001119 ..... N88-18069 #
DE88-001123 ..... N88-18070 #
DE88-001397 ..... N88-18080 #
DE88-001420 ..... N88-18505 #
DE88-001555 ..... N88-18508 #
DE88-001773 ..... N88-17945 #
DE88-001938 ..... N88-17814 #
DE88-001953 ..... N88-18404 #
DE88-002110 ..... N88-17927 #
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DE88-002263 ..... N88-18368 #
DE88-002303 ..... N88-18378 #
DE88-002338 ..... N88-18071 #
DE88-002342 ..... N88-18494 #
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DE88-002428 ..... N88-17902 #
DE88-002641 ..... N88-18018 #
DE88-002642 ..... N88-18461 #
DE88-002644 ..... N88-18034 #
DE88-002702 ..... N88-18190 #
DE88-002776 ..... N88-18001 #
DE88-002851 ..... N88-18064 #
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DE88-002887 ..... N88-18065 #
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DE88-002948 ..... N88-17926 #
DE88-002971 ..... N88-17812 #
DE88-002981 ..... N88-17751 #
DE88-003002 ..... N88-18449 #
DE88-003009 ..... N88-17781 #
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DE88-003016 ..... N88-18445 #
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DE88-003041 ..... N88-17755 #
DE88-003067 ..... N88-17752 #
DE88-003080 ..... N88-18452 #
DE88-003096 ..... N88-18453 #
DE88-003098 ..... N88-18287 #
DE88-003111 ..... N88-17800 #
DE88-003118 ..... N88-18454 #
DE88-003132 ..... N88-17813 #
DE88-003146 ..... N88-17975 #
DE88-003147 ..... N88-18543 #
DE88-003150 ..... N88-17974 #
DE88-003163 ..... N88-18405 #
DE88-003185 ..... N88-17983 #
DE88-003224 ..... N88-17788 #
DE88-003254 ..... N88-18381 #
DE88-003282 ..... N88-18382 #
DE88-003286 ..... N88-18327 #
DE88-003296 ..... N88-18530 #
DE88-003300 ..... N88-18455 #
DE88-003309 ..... N88-18515 #
DE88-003333 ..... N88-17763 #
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DE88-003383 ..... N88-18504 #
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DE88-003408 ..... N88-18496 #
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DE88-003411 ..... N88-18531 #
DE88-003412 ..... N88-18532 #
DE88-003415 ..... N88-17785 #
DE88-003429 ..... N88-17786 #
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DE88-003478 ..... N88-18476 #
DE88-003479 ..... N88-18477 #
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DE88-003489 ..... N88-18533 #
DE88-003491 ..... N88-17907 #
DE88-003493 ..... N88-18478 #
DE88-003495 ..... N88-18479 #
DE88-003497 ..... N88-18318 #
DE88-003508 ..... N88-18383 #
DE88-003510 ..... N88-17764 #
DE88-003515 ..... N88-18108 #
DE88-003530 ..... N88-18328 #
DE88-003534 ..... N88-18304 #
DE88-003536 ..... N88-18260 #
DE88-003537 ..... N88-18261 #
DE88-003539 ..... N88-18262 #
DE88-003540 ..... N88-18263 #
DE88-003545 ..... N88-17969 #
DE88-003547 ..... N88-17787 #
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DE88-003564 ..... N88-18466 #
DE88-003567 ..... N88-18317 #
DE88-003568 ..... N88-18305 #
DE88-003570 ..... N88-18306 #
DE88-003571 ..... N88-18307 #
DE88-003572 ..... N88-18311 #
DE88-003573 ..... N88-18313 #
DE88-003574 ..... N88-18274 #
DE88-003576 ..... N88-18314 #
DE88-003582 ..... N88-18312* #
DE88-003583 ..... N88-18340 #
DE88-003584 ..... N88-18275 #
DE88-003589 ..... N88-18276 #
DE88-003590 ..... N88-18308 #
DE88-003591 ..... N88-18288 #
DE88-003592 ..... N88-18309 #
DE88-003599 ..... N88-18282 #
DE88-003620 ..... N88-18437 #
DE88-003654 ..... N88-17949 #
DE88-003665 ..... N88-18424 #
DE88-003680 ..... N88-18110 #
DE88-003732 ..... N88-17804 #
DE88-003748 ..... N88-18059 #
DE88-003749 ..... N88-18060 #
DE88-003760 ..... N88-18264 #
DE88-003767 ..... N88-18384 #
DE88-003770 ..... N88-17911 #
DE88-003786 ..... N88-18428 #
DE88-003795 ..... N88-18066 #
DE88-003796 ..... N88-18072 #
DE88-003799 ..... N88-18406 #
DE88-003800 ..... N88-18391 #
DE88-003811 ..... N88-18429 #
DE88-003828 ..... N88-17977 #
DE88-003831 ..... N88-17970 #
DE88-003846 ..... N88-17806 #
DE88-003850 ..... N88-18121 #
DE88-003854 ..... N88-17888 #
DE88-003856 ..... N88-18480 #
DE88-003863 ..... N88-18467 #
DE88-003864 ..... N88-18468 #
DE88-003875 ..... N88-17978 #
DE88-003894 ..... N88-18407 #
DE88-003909 ..... N88-18082 #
DE88-003934 ..... N88-18469 #
DE88-003935 ..... N88-18470 #
DE88-003943 ..... N88-18385 #
DE88-003957 ..... N88-17979 #
DE88-003960 ..... N88-17811 #
DE88-003961 ..... N88-18326 #
DE88-003978 ..... N88-18005 #
DE88-003995 ..... N88-18471 #
DE88-003998 ..... N88-18430 #
DE88-003999 ..... N88-18402 #
DE88-004007 ..... N88-17742 #
DE88-004012 ..... N88-17971 #
DE88-004013 ..... N88-18265 #
DE88-004039 ..... N88-17980 #
DE88-004044 ..... N88-18425 #
DE88-004053 ..... N88-17807 #
DE88-004074 ..... N88-18481 #
DE88-004085 ..... N88-17808 #
DE88-004088 ..... N88-17760 #
DE88-004094 ..... N88-17981 #
DE88-004096 ..... N88-18392 #
DE88-004098 ..... N88-18369 #
DE88-004100 ..... N88-18397 #
DE88-004116 ..... N88-17984 #
DE88-004147 ..... N88-17966 #
DE88-004155 ..... N88-18431 #
DE88-004165 ..... N88-18096 #
DE88-004170 ..... N88-18081 #
DE88-004175 ..... N88-18438 #
DE88-004177 ..... N88-18439 #
DE88-004178 ..... N88-17883 #
DE88-004179 ..... N88-18440 #
DE88-004191 ..... N88-18277 #
DE88-004197 ..... N88-17818 #
DE88-004236 ..... N88-18497 #
DE88-004237 ..... N88-18536 #
DE88-004246 ..... N88-18386 #
DE88-004272 ..... N88-17789 #
DE88-004287 ..... N88-18541 #
DE88-004288 ..... N88-17985 #
DE88-004291 ..... N88-18387 #
DE88-004299 ..... N88-17986 #
DE88-004304 ..... N88-18546 #
DE88-004305 ..... N88-18341 #
DE88-004308 ..... N88-18498 #
DE88-004309 ..... N88-18537 #
DE88-004314 ..... N88-17987 #
DE88-004317 ..... N88-17988 #
DE88-004320 ..... N88-18482 #
DE88-004321 ..... N88-18408 #
DE88-004332 ..... N88-18388 #
DE88-004333 ..... N88-17790 #
DE88-004356 ..... N88-18432 #
DE88-004385 ..... N88-18509 #
DE88-004397 ..... N88-18433 #
DE88-004406 ..... N88-18434 #
DE88-004425 ..... N88-18499 #
DE88-004431 ..... N88-17989 #
DE88-004434 ..... N88-18359 #
DE88-004443 ..... N88-18472 #
DE88-004448 ..... N88-18372 #
DE88-004465 ..... N88-18393 #
DE88-004476 ..... N88-18394 #
DE88-004527 ..... N88-17765 #
DE88-004531 ..... N88-18500 #
DE88-004555 ..... N88-17889 #
DE88-004556 ..... N88-18483 #
DE88-004561 ..... N88-17912 #
DE88-004571 ..... N88-18501 #
DE88-004641 ..... N88-18038 #
DE88-004651 ..... N88-18473 #
DE88-004656 ..... N88-17908 #
DE88-004697 ..... N88-18266 #
DE88-004712 ..... N88-18435 #
DE88-004717 ..... N88-18073 #
DE88-004719 ..... N88-18389 #
DE88-004726 ..... N88-17726 #
DE88-004727 ..... N88-18283 #
DE88-004736 ..... N88-18510 #
DE88-004765 ..... N88-18329 #
DE88-004772 ..... N88-18074 #
DE88-004773 ..... N88-18436 #
DE88-004778 ..... N88-18284 #
DE88-004795 ..... N88-17687 #
DE88-004804 ..... N88-18474 #
DE88-004854 ..... N88-17809 #
DE88-004856 ..... N88-18484 #
DE88-004859 ..... N88-17990 #
DE88-004863 ..... N88-18319 #
DE88-004864 ..... N88-17991 #
DE88-004922 ..... N88-18502 #
DE88-004956 ..... N88-17791 #
DE88-004960 ..... N88-17952 #
DE88-005026 ..... N88-17992 #
DE88-005028 ..... N88-17993 #
DE88-005062 ..... N88-18441 #
DE88-005063 ..... N88-17994 #
DE88-005083 ..... N88-17766 #
DE88-005085 ..... N88-17953 #
DE88-005087 ..... N88-18520 #
DE88-005091 ..... N88-17909 #
DE88-005092 ..... N88-18365 #
DE88-005213 ..... N88-18442 #
DE88-005214 ..... N88-18342 #
DE88-005243 ..... N88-17792 #
DE88-005244 ..... N88-18006 #
DE88-700356 ..... N88-18412 #
DE88-700404 ..... N88-18492 #
DE88-700412 ..... N88-17775 #
DE88-700448 ..... N88-18526 #
DE88-700470 ..... N88-18400 #
DE88-700471 ..... N88-18415 #
DE88-700595 ..... N88-18330 #
DE88-700603 ..... N88-18457 #
DE88-700613 ..... N88-18019 #
DE88-700618 ..... N88-18529 #
DE88-700619 ..... N88-18090 #
DE88-700620 ..... N88-18458 #
DE88-700639 ..... N88-17904 #
DE88-700649 ..... N88-18547 #
DE88-700675 ..... N88-17756 #
DE88-700676 ..... N88-17757 #
DE88-700684 ..... N88-18426 #
DE88-700687 ..... N88-18542 #
DE88-700713 ..... N88-18495 #
DE88-700724 ..... N88-18278 #
DE88-750307 ..... N88-17771 #
DE88-751051 ..... N88-18367 #
DE88-751066 ..... N88-18416 #
DE88-751067 ..... N88-18417 #
DE88-751071 ..... N88-18418 #
DE88-900129 ..... N88-18120 #
DE88-900241 ..... N88-18061 #

DODA-AR-004-522 ..... N88-17917 #
DODA-AR-004-548 ..... N88-18024 #
DODA-AR-004-552 ..... N88-18023 #
DODA-AR-004-555 ..... N88-17735 #
DODA-AR-005-145 ..... N88-17973 #

DOE/AL-33183/T5 ..... N88-17948 #

DOE/BP-11191/13 ..... N88-18060 #
DOE/BP-11191/14 ..... N88-18059 #

DOE/CE-0201 ..... N88-17811 #

DOE/ER-04971/8 ..... N88-18386 #

DOE/ER-10618/22 ..... N88-18389 #
DOE/ER-10676/10 ..... N88-18392 #
DOE/ER-12037/2 ..... N88-17806 #
DOE/ER-13142/T1 ..... N88-18001 #
DOE/ER-13174/T8 ..... N88-17952 #
DOE/ER-13191/8 ..... N88-17981 #
DOE/ER-13213/10 ..... N88-17989 #
DOE/ER-13331/1 ..... N88-18504 #
DOE/ER-13363/T1 ..... N88-17764 #
DOE/ER-13488/2 ..... N88-18500 #
DOE/ER-13501/01 ..... N88-18393 #
DOE/ER-13506/3 ..... N88-18065 #
DOE/ER-13515/3 ..... N88-18382 #
DOE/ER-13521/T1 ..... N88-18383 #
DOE/ER-13530/1 ..... N88-18096 #
DOE/ER-13678/7 ..... N88-17763 #
DOE/ER-13761/1 ..... N88-17992 #
DOE/ER-13761/4 ..... N88-17993 #
DOE/ER-25001/T1 ..... N88-18466 #
DOE/ER-25001/T2 ..... N88-18456 #
DOE/ER-25001/36 ..... N88-18308 #
DOE/ER-25001/37 ..... N88-18276 #
DOE/ER-25001/38 ..... N88-18274 #
DOE/ER-25001/39 ..... N88-18313 #
DOE/ER-25001/41 ..... N88-18314 #
DOE/ER-25001/43 ..... N88-18282 #
DOE/ER-25001/51 ..... N88-18309 #
DOE/ER-25001/52 ..... N88-18288 #
DOE/ER-25001/60 ..... N88-18317 #
DOE/ER-25001/61 ..... N88-18305 #
DOE/ER-25001/63 ..... N88-18306 #
DOE/ER-25001/64 ..... N88-18307 #
DOE/ER-25001/65 ..... N88-18311 #
DOE/ER-25001/70 ..... N88-18312* #
DOE/ER-25001/73 ..... N88-18275 #
DOE/ER-25001/78 ..... N88-18340 #
DOE/ER-25001/89 ..... N88-18328 #
DOE/ER-25001/92 ..... N88-18304 #
DOE/ER-25001/94 ..... N88-18260 #
DOE/ER-25001/95 ..... N88-18261 #
DOE/ER-25009/449 ..... N88-18262 #
DOE/ER-25009/451 ..... N88-18263 #
DOE/ER-25016/6 ..... N88-17984 #
DOE/ER-25026/8-12/87 ..... N88-18342 #
DOE/ER-25033/1 ..... N88-18369 #
DOE/ER-40032/9 ..... N88-18390 #
DOE/ER-40048/205-L7 ..... N88-18496 #
DOE/ER-40048/206-L7 ..... N88-18497 #
DOE/ER-40219/3 ..... N88-18502 #
DOE/ER-40325/03 ..... N88-18494 #
DOE/ER-40343/1 ..... N88-18397 #
DOE/ER-45092/T3 ..... N88-17808 #
DOE/ER-45190/1 ..... N88-18499 #
DOE/ER-45205/3 ..... N88-17788 #
DOE/ER-45258/T2 ..... N88-18378 #
DOE/ER-45273/1 ..... N88-17976 #
DOE/ER-45286/1 ..... N88-17807 #
DOE/ER-45294/T1 ..... N88-18481 #
DOE/ER-45308/1 ..... N88-17791 #
DOE/ER-53212/115 ..... N88-18431 #
DOE/ER-53220/T3 ..... N88-18437 #
DOE/ER-53220/T4 ..... N88-18381 #
DOE/ER-53252/4 ..... N88-18442 #
DOE/ER-60264/T1 ..... N88-18081 #
DOE/ER-60418/T1 ..... N88-18017 #
DOE/ER-60435/T3 ..... N88-18108 #
DOE/ER-60450/T1 ..... N88-18110 #

DOE/FE-0096 ..... N88-18076 #

DOE/ID-12380/18 ..... N88-17906 #

DOE/MC-21181/1950-VOL-9 ..... N88-18050 #
DOE/MC-21181/1950-VOL-10 ..... N88-18048 #
DOE/MC-23264/2507 ..... N88-18058 #

DOE/METC-88-4075 ..... N88-17762 #

DOE/OR-00033/T382 ..... N88-17765 #
DOE/OR-21400/T325 ..... N88-18407 #

DOE/PC-80503/T9 ..... N88-18474 #
DOE/PC-90959/T4 ..... N88-18375 #

DOT/FAA/CT-87/15 ..... N88-18022* #

DOT/FAA/PS-88/7 ..... N88-17616* #

DP-MS-87-14 ..... N88-17789 #
DP-MS-87-141 ..... N88-18264 #

DPD-614-VOL-1 ..... N88-17721* #
DPD-614-VOL-2 ..... N88-17722* #
DPD-614-VOL-2-APP-D ..... N88-17724* #
DPD-614-VOL-2-APP-E ..... N88-17723* #

DR-4-VOL-2-APP-D ..... N88-17724* #
DR-4-VOL-2-APP-E ..... N88-17723* #
DR-5-VOL-1 ..... N88-17721* #
DR-5-VOL-2 ..... N88-17722* #

D180-27863-1-VOL-1 ..... N88-17721* #
D180-27863-2-VOL-2 ..... N88-17722* #
D180-27863-2-VOL-2-APP-D ..... N88-17724* #
D180-27863-2-VOL-2-APP-E ..... N88-17723* #
D180-30708-1 ..... N88-17688* #

E-3218 ..... N88-17686* #
E-3853 ..... N88-17582* #
E-3856 ..... N88-17731* #
E-3891 ..... N88-18379* #
E-3897 ..... N88-17954* #
E-3908 ..... N88-18036* #
E-3934 ..... N88-18007* #
E-3936 ..... N88-17744* #
E-3942 ..... N88-17796* #
E-3945 ..... N88-17745* #
E-3948 ..... N88-17899* #
E-3954 ..... N88-17801* #
E-3958 ..... N88-17715* #
E-3961 ..... N88-17728* #
E-3972 ..... N88-18040* #
E-3981 ..... N88-17880* #

EFR-010-REV-A ..... N88-17641 #

EL-190 ..... N88-17876

EPA/600/D-87/319 ..... N88-18149 #
EPA/600/3-87/047 ..... N88-18095 #
EPA/600/3-87/048 ..... N88-18104 #
EPA/600/4-87/033 ..... N88-17759 #

EPRI-EA-5473 ..... N88-18080 #

EPRI-NP-5129 ..... N88-17773 #

ESA-CR(P)-2485 ..... N88-17901 #
ESA-CR(P)-2487 ..... N88-17719 #
ESA-CR(P)-2491-VOL-1 ..... N88-17689 #
ESA-CR(P)-2511 ..... N88-17690 #

ESD-TR-87-173 ..... N88-18291 #
ESD-TR-87-186 ..... N88-18290 #

ETL-0458 ..... N88-18055 #
ETL-0473 ..... N88-18056 #
ETL-0479 ..... N88-17640 #

ETN-88-91025 ..... N88-17819 #
ETN-88-91460 ..... N88-18525
ETN-88-91511 ..... N88-17772 #
ETN-88-91629 ..... N88-18000 #
ETN-88-91677 ..... N88-18414 #
ETN-88-91699 ..... N88-17901 #
ETN-88-91700 ..... N88-17719 #
ETN-88-91702-VOL-1 ..... N88-17689 #
ETN-88-91706 ..... N88-17690 #

EUR-10099 ..... N88-18120 #
EUR-10523 ..... N88-18061 #

FEI-1787 ..... N88-18330 #

FEW-219 ..... N88-18281 #

FM-11 ..... N88-17958 #

FNAL/C-87/161-A ..... N88-18531 #
FNAL/C-87/163-A ..... N88-18532 #
FNAL/C-87/164-A ..... N88-18535 #
FNAL/C-87/167-A ..... N88-18496 #
FNAL/C-87/168-A ..... N88-18534 #

FOA-C-20674-2.6 ..... N88-17740 #
FOA-C-20675-2.6 ..... N88-17741 #
FOA-C-20676-2.1 ..... N88-17817 #
FOA-C-30463-3.2 ..... N88-17884 #
FOA-C-30471-3.3 ..... N88-18286 #

FPRSC(86)P6 ..... N88-18014 #

FPWG/P1009 ..... N88-17779 #

FRDCC/MWG/FSG/P(86)77 ..... N88-17777 #

FRDCC/MWG/MPSG/P(86)171 ..... N88-17777 #

FRDCC/MWG/P(86)389 ..... N88-17777 #

FTD-ID(RS)T-0721-87 ..... N88-18010 #

FVI-87-01 ..... N88-18280 #

GAL-1004 ..... N88-18112 #

GI-86-51B ..... N88-18096 #

GL-4240 ..... N88-17767 #
GL-4294 ..... N88-18021 #

GRI-87/0216 ..... N88-17805 #
GRI-87/0261 ..... N88-18057 #
GRI-87/0328 ..... N88-18093 #

GWU/SEAS-TR-ES-87-4 ..... N88-18001 #

H-1432 ..... N88-17644* #

HEL-TN-6-87-REV-A ..... N88-17641 #

HL-88-5 ..... N88-18376* #

HL86/1431 ..... N88-18014 #
HL86/1437 ..... N88-17798 #
HL86/1452 ..... N88-18015 #
HL87/1006 ..... N88-17777 #
HL87/1017 ..... N88-17736 #
HL87/1021 ..... N88-17754 #
HL87/1055 ..... N88-17753 #
HL87/1100 ..... N88-18026 #
HL87/1108 ..... N88-18027 #
HL87/1123 ..... N88-18016 #
HL87/1204 ..... N88-17776 #
HL87/1213 ..... N88-17779 #
HL87/1224 ..... N88-17778 #

IAE-4333/7 ..... N88-18412 #
IAE-4345/10 ..... N88-18457 #

IAEA-TECDOC-407 ..... N88-18019 #

ICASE-88-1 ..... N88-18272* #
ICASE-88-3 ..... N88-18279* #
ICASE-88-5 ..... N88-18301* #
ICASE-88-6 ..... N88-18299* #
ICASE-88-7 ..... N88-18332* #
ICASE-88-9 ..... N88-17684* #
ICASE-88-10 ..... N88-17955* #
ICASE-88-11 ..... N88-18345* #
ICASE-88-12 ..... N88-18346* #

IFT-P-09/87 ..... N88-18529 #
IFT-P-10/87 ..... N88-18090 #
IFT-P-13/86 ..... N88-18458 #

IFVE-ONF-86-217 ..... N88-17904 #

IFVE-OTF-86-190 ..... N88-18492 #
IFVE-OTF-86-207 ..... N88-18547 #

INIS-BR-878 ..... N88-17775 #

IPPJ-854 ..... N88-18420 #
IPPJ-855 ..... N88-18419 #

IR-128 ..... N88-18334 #

ISAL-IDI-187-10 ..... N88-18000 #

ISBN-0-947767-84-3 ..... N88-18176 #
ISBN-92-835-0433-X ..... N88-17647 #
ISBN-92-835-2113-7 ..... N88-17682 #
ISBN-951-753-978-9 ..... N88-18067 #
ISBN-951-754-152-X ..... N88-18179 #
ISBN-951-754-218-6 ..... N88-17881 #

ISSN-0038-0911 ..... N88-18544 #
ISSN-0038-0911 ..... N88-18545 #
ISSN-0348-7539 ..... N88-18414 #
ISSN-0389-4010 ..... N88-17613 #
ISSN-0389-4010 ..... N88-17730 #
ISSN-0389-4010 ..... N88-17769 #
ISSN-0389-4010 ..... N88-17770 #
ISSN-0389-4010 ..... N88-17963 #
ISSN-0389-4010 ..... N88-18062 #
ISSN-0469-4732 ..... N88-18419 #
ISSN-0469-4732 ..... N88-18420 #
ISSN-0831-9751 ..... N88-17819 #

ITEF-27(1986) ..... N88-17756 #
ITEF-28(1986) ..... N88-17757 #
ITEF-92-1986 ..... N88-18526 #
ITEF-105(1986) ..... N88-18426 #

ITEP-1(1986) ..... N88-18542 #

JAERI-M-87-095 ..... N88-17771 #

JAERI-M-87-103 ..... N88-18417 #
JAERI-M-87-108 ..... N88-18416 #
JAERI-M-87-111 ..... N88-18418 #

JHU/APL/TG-1365 ..... N88-18053 #

JINR-R-2-86-148 ..... N88-18495 #
JINR-R-10-86-751 ..... N88-18278 #

JINR-13-86-566 ..... N88-18400 #
JINR-13-86-736 ..... N88-18415 #

JPL-PUBL-82-43 ..... N88-18538* #
JPL-PUBL-83-39-REV-3 ..... N88-18523* #
JPL-PUBL-87-4-VOL-4 ..... N88-18083* #
JPL-PUBL-87-39 ..... N88-17891* #
JPL-PUBL-88-3 ..... N88-17890* #
JPL-PUBL-88-4 ..... N88-18524* #
JPL-PUBL-88-6 ..... N88-18008* #

JPRS-ELS-88-002 ..... N88-17870 #

JPRS-USB-88-003 ..... N88-18122 #
JPRS-USB-88-004 ..... N88-18150 #

K/CSD/TM-76 ..... N88-18509 #

K/D-5739 ..... N88-17687 #

KMSF-U-1877 ..... N88-18429 #

KSL-87-01 ..... N88-18323 #

L-16212 ..... N88-17615* #
L-16373 ..... N88-18443* #
L-16393 ..... N88-17614* #
L-16403 ..... N88-18302* #

LA-SUB-H2050E-1 ..... N88-17742 #

LA-UR-87-3046 ..... N88-17975 #
LA-UR-87-3092 ..... N88-17983 #
LA-UR-87-3888 ..... N88-18405 #
LA-UR-87-3964 ..... N88-17974 #
LA-UR-87-3998 ..... N88-18543 #
LA-UR-87-4002 ..... N88-18406 #
LA-UR-87-4010 ..... N88-18482 #
LA-UR-87-4015 ..... N88-17986 #
LA-UR-87-4033 ..... N88-17987 #
LA-UR-87-4104 ..... N88-18537 #
LA-UR-87-4119 ..... N88-18498 #
LA-UR-87-4146 ..... N88-18341 #
LA-UR-87-4159 ..... N88-18546 #
LA-UR-87-4199 ..... N88-18541 #
LA-UR-87-4214 ..... N88-17985 #
LA-UR-87-4227 ..... N88-18387 #
LA-UR-87-4297 ..... N88-17996 #

LA-6949-MS-REV-2 ..... N88-17814 #
LA-10905-MS-PT-2 ..... N88-17909 #
LA-10948-MS ..... N88-18520 #
LA-10971-MS ..... N88-17766 #
LA-11128-SR ..... N88-18404 #
LA-11132-MS ..... N88-18372 #
LA-11148-MS ..... N88-17971 #
LA-11158-M ..... N88-17953 #
LA-11172-MS ..... N88-18365 #
LA-11189-MS ..... N88-17908 #
LA-11190-MS ..... N88-18359 #
LA-11198-MS ..... N88-18265 #
LA-11204-MS ..... N88-18266 #

LBL-22724 ..... N88-18062 #
LBL-23286 ..... N88-17912 #
LBL-23304 ..... N88-17889 #
LBL-23656 ..... N88-18517* #
LBL-23817 ..... N88-17888 #
LBL-23875 ..... N88-18467 #
LBL-24017 ..... N88-18121 #
LBL-24139 ..... N88-18468 #
LBL-24140 ..... N88-18480 #
LBL-24166 ..... N88-18483 #
LBL-24514 ..... N88-18501 #

LC-79-640375 ..... N88-18544 #
LC-79-640375 ..... N88-18545 #
LC-87-14156 ..... N88-18084* #
LC-87-619862 ..... N88-18401 #
LC-87-619875 ..... N88-17967 #

LIDS-P-1665 ..... N88-18380 #
LIDS-P-1666 ..... N88-18358 #

MA-RD-760-87039 ..... N88-17926 #

MBB-FM-315/O ..... N88-17825 #

MBB-RA3-004/87-VOL-1 ..... N88-17889 #

MBB-RVD-RVDV-SVS-REP-ERNO-01 ..... N88-17719 #

MBB-UA-940/86 ..... N88-17861 #
MBB-UA-1013/86 ..... N88-17838 #
MBB-UA-1044/87 ..... N88-17864 #
MBB-UA-1045/87 ..... N88-17862 #
MBB-UA-1046/87 ..... N88-17855 #
MBB-UA-1047/87 ..... N88-17863 #
MBB-UA-1049/87 ..... N88-17860 #

MBB-UD-472/86 ..... N88-17854 #
MBB-UD-487/86 ..... N88-17853 #

MBB-UR-911/86 ..... N88-17857 #
MBB-UR-931/86 ..... N88-17856 #
MBB-UR-944/87 ..... N88-17859 #
MBB-UR-949/70 ..... N88-17828 #

MBB-URE-943/87 ..... N88-17858 #

MBB-UT-002/87 ..... N88-17849 #
MBB-UT-004/87 ..... N88-17836 #
MBB-UT-005/87 ..... N88-17847 #
MBB-UT-006/87 ..... N88-17848 #
MBB-UT-007/87 ..... N88-17850 #
MBB-UT-008/87 ..... N88-17851 #
MBB-UT-102/87 ..... N88-17852 #

MBB-Z-101/86 ..... N88-17833 #
MBB-Z-111/87 ..... N88-17837 #
MBB-Z-136/86 ..... N88-17839 #
MBB-Z-137/86 ..... N88-17840 #
MBB-Z-138/87 ..... N88-17835 #
MBB-Z-139/87 ..... N88-17834 #
MBB-Z-141/87 ..... N88-17865 #
MBB-Z-546/83 ..... N88-17841 #

MBB-303-16/86 ..... N88-17719 #

MBB/LK-S/PUB/296 ..... N88-17842 #

MBB/LKE-1/S/PUB/120 ..... N88-17843 #
MBB/LKE-82/S/PUB/292 ..... N88-17844 #
MBB/LKE-122/S/PUB/226 ..... N88-17846 #
MBB/LKE-294/S/PUB/295 ..... N88-17845 #

MIT/LCS/TR-407 ..... N88-18273 #

MLM-3470 ..... N88-17792 #
MLM-3479 ..... N88-18006 #

MM:1985/86-LY-14 ..... N88-17982 #
MM:1986/87-ZY-1 ..... N88-18403 #

MML-TR-87-75C ..... N88-17794 #

MPE-PREPRINT-97 ..... N88-18525

MRL-R-1084 ..... N88-17973 #

MT-CWR-088-003 ..... N88-17791 #

NAEC-92-191 ..... N88-17758 #

NAL-TR-931 ..... N88-18062 #
NAL-TR-932 ..... N88-17963 #
NAL-TR-939 ..... N88-17769 #
NAL-TR-941 ..... N88-17770 #
NAL-TR-942 ..... N88-17730 #
NAL-TR-943 ..... N88-17613 #

NAMRL-1332 ..... N88-18186 #

NAS 1.15:4025 ..... N88-18106* #
NAS 1.15:4028 ..... N88-18302* #
NAS 1.15:89466 ..... N88-18174* #
NAS 1.15:89709 ..... N88-18046* #
NAS 1.15:89710 ..... N88-17924* #
NAS 1.15:89711 ..... N88-18517* #
NAS 1.15:100033 ..... N88-17646* #
NAS 1.15:100042 ..... N88-17584* #
NAS 1.15:100048 ..... N88-17581* #
NAS 1.15:100059 ..... N88-17743* #
NAS 1.15:100060 ..... N88-18320* #
NAS 1.15:100069 ..... N88-18366* #
NAS 1.15:100074 ..... N88-18344* #
NAS 1.15:100075 ..... N88-18343* #
NAS 1.15:100084 ..... N88-17645* #
NAS 1.15:100262 ..... N88-18379* #
NAS 1.15:100272 ..... N88-18036* #
NAS 1.15:100288 ..... N88-18007* #
NAS 1.15:100294 ..... N88-17796* #
NAS 1.15:100297 ..... N88-17745* #
NAS 1.15:100300 ..... N88-17899* #
NAS 1.15:100303 ..... N88-18548* #
NAS 1.15:100319 ..... N88-18004* #
NAS 1.15:100413 ..... N88-17644* #
NAS 1.15:100540 ..... N88-17737* #
NAS 1.15:100554 ..... N88-17739* #
NAS 1.15:100782 ..... N88-17801* #
NAS 1.15:100786 ..... N88-17715* #
NAS 1.15:100788 ..... N88-17728* #
NAS 1.15:100793 ..... N88-17744* #
NAS 1.15:100796 ..... N88-18040* #
NAS 1.15:100808 ..... N88-17880* #
NAS 1.15:100979 ..... N88-18177* #
NAS 1.15:100980 ..... N88-18148* #
NAS 1.19:251(M) ..... N88-17725* #
NAS 1.21:490 ..... N88-18084* #
NAS 1.21:7011(306) N88-18180*
NAS 1.21:7011(308) N88-18183*
NAS 1.21:7039(32)-SECT-2 ..... N88-18511*
NAS 1.21:7041(56) N88-18051*
NAS 1.26:3922(18) ..... N88-18175* #
NAS 1.26:4115 ..... N88-17582* #
NAS 1.26:4125 ..... N88-18427* #
NAS 1.26:177429 ..... N88-17585* #
NAS 1.26:177463 ..... N88-17720* #
NAS 1.26:178401 ..... N88-17738* #
NAS 1.26:179268 ..... N88-17721* #
NAS 1.26:179272 ..... N88-17722* #
NAS 1.26:179273 ..... N88-17724* #
NAS 1.26:179274 ..... N88-17723* #
NAS 1.26:179275 ..... N88-17716* #
NAS 1.26:179276 ..... N88-17717* #
NAS 1.26:179277 ..... N88-18091* #
NAS 1.26:179281 ..... N88-17688* #
NAS 1.26:179489 ..... N88-18068* #
NAS 1.26:180464 ..... N88-18398* #
NAS 1.26:180749 ..... N88-17964* #
NAS 1.26:180834 ..... N88-17731* #
NAS 1.26:180865 ..... N88-17732* #
NAS 1.26:180873 ..... N88-17954* #
NAS 1.26:181449 ..... N88-18540* #
NAS 1.26:181602 ..... N88-17727* #
NAS 1.26:181608 ..... N88-18272* #
NAS 1.26:181612 ..... N88-18279* #
NAS 1.26:181614 ..... N88-18301* #
NAS 1.26:181615 ..... N88-18299* #
NAS 1.26:181616 ..... N88-18332* #
NAS 1.26:181618 ..... N88-17684* #
NAS 1.26:181619 ..... N88-17955* #
NAS 1.26:181620 ..... N88-18345* #
NAS 1.26:181621 ..... N88-18346* #
NAS 1.26:182473 ..... N88-18022* #
NAS 1.26:182482 ..... N88-17782* #
NAS 1.26:182487 ..... N88-18331* #
NAS 1.26:182488 ..... N88-18049* #
NAS 1.26:182489 ..... N88-17784* #
NAS 1.26:182499 ..... N88-18035* #
NAS 1.26:182506 ..... N88-17802* #
NAS 1.26:182509 ..... N88-18376* #
NAS 1.26:182510 ..... N88-17583* #
NAS 1.26:182514 ..... N88-18259* #
NAS 1.26:182518 ..... N88-17733* #
NAS 1.26:182519 ..... N88-17761* #
NAS 1.26:182520 ..... N88-18524* #
NAS 1.26:182521 ..... N88-18312* #
NAS 1.26:182522 ..... N88-17890* #
NAS 1.26:182523 ..... N88-17891* #
NAS 1.26:182524 ..... N88-18523* #
NAS 1.26:182525 ..... N88-18538* #
NAS 1.26:182526 ..... N88-18008* #
NAS 1.26:182527 ..... N88-18083* #
NAS 1.26:182528 ..... N88-18267* #
NAS 1.26:182530 ..... N88-18289* #
NAS 1.26:182531 ..... N88-18106* #
NAS 1.26:182532 ..... N88-17892* #
NAS 1.26:182534 ..... N88-18097* #
NAS 1.26:182535 ..... N88-18105* #
NAS 1.26:182537 ..... N88-18300* #
NAS 1.26:182541 ..... N88-17612* #
NAS 1.55:2432 ..... N88-17586* #
NAS 1.55:2500 ..... N88-17691* #
NAS 1.55:10006 ..... N88-17616* #
NAS 1.60:2681 ..... N88-17686* #
NAS 1.60:2771 ..... N88-17615* #
NAS 1.60:2798 ..... N88-18443* #
NAS 1.60:2806 ..... N88-17614* #
NAS 1.60:2807 ..... N88-17869* #
NAS 1.77:20204 ..... N88-17803* #
NAS 1.77:20206 ..... N88-18482* #
NAS 1.77:20215 ..... N88-18181* #
NAS 1.77:20217 ..... N88-18182* #

NASA-CP-2432 ..... N88-17586* #
NASA-CP-2500 ..... N88-17691* #
NASA-CP-10006 ..... N88-17616* #

NASA-CR-3922(18) ..... N88-18175* #

NASA-CR-4115 ..... N88-17582* #
NASA-CR-4125 ..... N88-18427* #
NASA-CR-177429 ..... N88-17585* #
NASA-CR-177463 ..... N88-17720* #
NASA-CR-178401 ..... N88-17738* #
NASA-CR-179268 ..... N88-17721* #
NASA-CR-179272 ..... N88-17722* #
NASA-CR-179273 ..... N88-17724* #
NASA-CR-179274 ..... N88-17723* #
NASA-CR-179275 ..... N88-17716* #
NASA-CR-179276 ..... N88-17717* #
NASA-CR-179277 ..... N88-18091* #
NASA-CR-179281 ..... N88-17688* #
NASA-CR-179489 ..... N88-18068* #
NASA-CR-180464 ..... N88-18396* #
NASA-CR-180749 ..... N88-17964* #
NASA-CR-180834 ..... N88-17731* #
NASA-CR-180865 ..... N88-17732* #
NASA-CR-180873 ..... N88-17954* #
NASA-CR-181449 ..... N88-18540* #
NASA-CR-181602 ..... N88-17727* #
NASA-CR-181608 ..... N88-18272* #
NASA-CR-181612 ..... N88-18279* #
NASA-CR-181614 ..... N88-18301* #
NASA-CR-181615 ..... N88-18299* #
NASA-CR-181616 ..... N88-18332* #
NASA-CR-181618 ..... N88-17684* #
NASA-CR-181619 ..... N88-17955* #
NASA-CR-181620 ..... N88-18345* #
NASA-CR-181621 ..... N88-18346* #
NASA-CR-182473 ..... N88-18022* #
NASA-CR-182482 ..... N88-17782* #
NASA-CR-182487 ..... N88-18331* #
NASA-CR-182488 ..... N88-18049* #
NASA-CR-182489 ..... N88-17784* #
NASA-CR-182490 ..... N88-18035* #
NASA-CR-182506 ..... N88-17802* #
NASA-CR-182509 ..... N88-18376* #
NASA-CR-182510 ..... N88-17583* #
NASA-CR-182514 ..... N88-18259* #
NASA-CR-182518 ..... N88-17733* #
NASA-CR-182519 ..... N88-17761* #
NASA-CR-182520 ..... N88-18524* #
NASA-CR-182521 ..... N88-18312* #
NASA-CR-182522 ..... N88-17890* #
NASA-CR-182523 ..... N88-17891* #
NASA-CR-182524 ..... N88-18523* #
NASA-CR-182525 ..... N88-18538* #
NASA-CR-182526 ..... N88-18008* #
NASA-CR-182527 ..... N88-18083* #
NASA-CR-182528 ..... N88-18267* #
NASA-CR-182530 ..... N88-18289* #
NASA-CR-182531 ..... N88-18106* #
NASA-CR-182532 ..... N88-17892* #
NASA-CR-182534 ..... N88-18097* #
NASA-CR-182535 ..... N88-18105* #
NASA-CR-182537 ..... N88-18300* #
NASA-CR-182541 ..... N88-17612* #

NASA-EP-251(M) ..... N88-17725* #

NASA-SP-490 ..... N88-18084* #
NASA-SP-7011(306) N88-18180*
NASA-SP-7011(308) N88-18183*
NASA-SP-7039(32)-SECT-2 ..... N88-18511*
NASA-SP-7041(56) N88-18051*

NASA-TM-4025 ..... N88-18109* #
NASA-TM-4028 ..... N88-18302* #
NASA-TM-89468 ..... N88-18174* #
NASA-TM-89709 ..... N88-18046* #
NASA-TM-89710 ..... N88-17924* #
NASA-TM-89711 ..... N88-18517* #
NASA-TM-100033 ..... N88-17646* #
NASA-TM-100042 ..... N88-17584* #
NASA-TM-100048 ..... N88-17581* #
NASA-TM-100059 ..... N88-17743* #
NASA-TM-100060 ..... N88-18320* #
NASA-TM-100069 ..... N88-18366* #
NASA-TM-100074 ..... N88-18344* #
NASA-TM-100075 ..... N88-18343* #
NASA-TM-100084 ..... N88-17645* #
NASA-TM-100262 ..... N88-18379* #
NASA-TM-100272 ..... N88-18036* #
NASA-TM-100288 ..... N88-18007* #
NASA-TM-100294 ..... N88-17796* #
NASA-TM-100297 ..... N88-17745* #
NASA-TM-100300 ..... N88-17899* #
NASA-TM-100303 ..... N88-18548* #
NASA-TM-100319 ..... N88-18004* #
NASA-TM-100413 ..... N88-17644* #
NASA-TM-100540 ..... N88-17737* #
NASA-TM-100554 ..... N88-17739* #
NASA-TM-100782 ..... N88-17801* #
NASA-TM-100786 ..... N88-17715* #
NASA-TM-100788 ..... N88-17728* #
NASA-TM-100793 ..... N88-17744* #
NASA-TM-100796 ..... N88-18040* #
NASA-TM-100808 ..... N88-17860* #
NASA-TM-100979 ..... N88-18177* #
NASA-TM-100980 ..... N88-18148* #

NASA-TP-2681 ..... N88-17666* #
NASA-TP-2771 ..... N88-17615* #
NASA-TP-2798 ..... N88-18443* #
NASA-TP-2806 ..... N88-17614* #
NASA-TP-2807 ..... N88-17869* #

NASA-TT-20204 ..... N88-17803* #
NASA-TT-20206 ..... N88-18462* #
NASA-TT-20215 ..... N88-18181* #
NASA-TT-20217 ..... N88-18182* #

NAVAIR-50-1C-547 ..... N88-18107 #

NBS/SP-250/20 ..... N88-18401 #
NBS/SP-250/22 ..... N88-17967 #

NBS/TN-1235 ..... N88-17999* #
NBS/TN-1239 ..... N88-17905 #

NBSIR-87/3076 ..... N88-17885 #
NBSIR-87/3611 ..... N88-18020 #
NBSIR-87/3613 ..... N88-18039 #
NBSIR-87/3668 ..... N88-17910 #

NBSIR/GCR-87/534 ..... N88-17950 #

NMAB-435 ..... N88-17802* #

NMERI-WA5-11(5.07) ..... N88-17871 #

NOAA-NWS-WRCP-42-REV-2 ..... N88-18101 #

NOAA-TM-ERL-ARL-156 ..... N88-18079 #

NOAA-TM-ERL-ESG-27-VOL-2 ..... N88-18092 #

NOAA-TM-NWS-WR-201 ..... N88-17873 #

NOR-87-85 ..... N88-18013 #

NORDA-170 ..... N88-18116 #
NORDA-211 ..... N88-18113 #
NORDA-211 ..... N88-18114 #

NOSC-TD-1148 ..... N88-17895 #
NOSC-TD-1161-VOL-1 ..... N88-17897 #
NOSC-TD-1161-VOL-2 ..... N88-17896 #
NOSC-TD-1162 ..... N88-17922 #

NPRDC-TN-88-2 ..... N88-18189 #

NPS52-87-037 ..... N88-18294 #
NPS52-87-042-PT-6 ..... N88-18270 #

NRL-MR-5854 ..... N88-17997 #
NRL-MR-5937 ..... N88-18044 #
NRL-MR-6073 ..... N88-18413 #
NRL-MR-6106 ..... N88-18399 #

NRL-9078 ..... N88-18100 #
NRL-9086 ..... N88-17894 #
NRL-9088 ..... N88-18303 #

NSWC/TR-86-342 ..... N88-17924* #
NSWC/TR-87-268 ..... N88-17898 #

NTIA-87-220 ..... N88-17875 #
NTIA-87-221 ..... N88-17874 #

NTSB/AAR-87/04-SUMM ..... N88-17639 #

NTSB/ARC-87/03 ..... N88-17638 #

NUSC-TR-7981 ..... N88-18269 #

ORNL/SUB-86-22042/1 ..... N88-17804 #
ORNL/SUB-86-47985/1 ..... N88-17949 #

ORNL/TM-10222 ..... N88-18424 #
ORNL/TM-10436 ..... N88-18436 #

PB87-126199 ..... N88-17734 #
PB88-105861 ..... N88-18187 #
PB88-112230 ..... N88-18179 #
PB88-112255 ..... N88-18178 #
PB88-112974 ..... N88-17881 #
PB88-114038 ..... N88-17873 #
PB88-114210 ..... N88-18281 #
PB88-114236 ..... N88-18067 #
PB88-115662 ..... N88-18101 #
PB88-116116 ..... N88-17874 #
PB88-116124 ..... N88-17875 #
PB88-118690 ..... N88-18280 #
PB88-120134 ..... N88-17926 #
PB88-120860 ..... N88-18079 #
PB88-121553 ..... N88-17882 #
PB88-121611 ..... N88-18310 #
PB88-123757 ..... N88-17905 #
PB88-123781 ..... N88-18401 #
PB88-123807 ..... N88-18092 #
PB88-124151 ..... N88-18094 #
PB88-124300 ..... N88-17759 #
PB88-124409 ..... N88-18518 #
PB88-124773 ..... N88-17999* #
PB88-125422 ..... N88-18149 #
PB88-126073 ..... N88-17727* #
PB88-126321 ..... N88-18285 #
PB88-126396 ..... N88-18377 #
PB88-126578 ..... N88-17884 #
PB88-126628 ..... N88-18286 #
PB88-126677 ..... N88-18335 #
PB88-126685 ..... N88-18336 #
PB88-126693 ..... N88-18334 #
PB88-126891 ..... N88-17951 #
PB88-126909 ..... N88-17887 #
PB88-126917 ..... N88-18337 #
PB88-126925 ..... N88-17886 #
PB88-127162 ..... N88-17685 #
PB88-127196 ..... N88-17637 #
PB88-127303 ..... N88-18403 #
PB88-127311 ..... N88-17982 #
PB88-127451 ..... N88-18338 #
PB88-127527 ..... N88-18339 #
PB88-127857 ..... N88-17740 #
PB88-128228 ..... N88-17741 #
PB88-128236 ..... N88-17817 #
PB88-128426 ..... N88-18544 #
PB88-128434 ..... N88-18545 #
PB88-130026 ..... N88-18057 #
PB88-130133 ..... N88-18095 #
PB88-130158 ..... N88-18503 #
PB88-130240 ..... N88-18104 #
PB88-131446 ..... N88-18333 #
PB88-131594 ..... N88-17761* #
PB88-135843 ..... N88-17638 #
PB88-138367 ..... N88-17967 #
PB88-138516 ..... N88-18519 #
PB88-141619 ..... N88-18093 #
PB88-141643 ..... N88-17805 #
PB88-153341 ..... N88-17950 #
PB88-153622 ..... N88-18039 #
PB88-153655 ..... N88-18020 #
PB88-155783 ..... N88-17910 #
PB88-155791 ..... N88-17885 #

PH-287 ..... N88-17878

PNL-SA-14137 ..... N88-17945 #
PNL-SA-14875 ..... N88-18385 #
PNL-SA-14931 ..... N88-18071 #
PNL-SA-15264 ..... N88-17786 #
PNL-SA-15322 ..... N88-17785 #

PRF-520-1288-0353 ..... N88-18376* #

PSU/ME-R-86/87-0034 ..... N88-17957 #

OR-2 ..... N88-18456 #

RA-236 ..... N88-17877

RE-738 ..... N88-17749 #

REF-87-24 ..... N88-18111 #

REPT-FM6 ..... N88-17829 #
REPT-FM15 ..... N88-17831 #
REPT-FM24 ..... N88-17829 #

REPT-MM-4 ..... N88-17821 #

REPT-TR-164 ..... N88-17830 #
REPT-TR-500 ..... N88-17832 #
REPT-TR-527 ..... N88-17826 #

REPT-86-MA-01 ..... N88-18187 #
REPT-87-11 ..... N88-17950 #
REPT-88B0049 ..... N88-17691* #
REPT-319 ..... N88-18339 #
REPT-323 ..... N88-18335 #
REPT-324 ..... N88-18336 #
REPT-0353-10 ..... N88-18376* #
REPT-1986-23 ..... N88-18377 #
REPT-1987-07 ..... N88-17951 #
REPT-1987-10 ..... N88-18338 #
REPT-1987-14 ..... N88-18337 #

REPT-1987-15 ..... N88-17886 #
REPT-1987-19 ..... N88-17887 #
REPT-8518-1 ..... N88-17690 #
REPT-8804 ..... N88-18176 #
REPT-93226 ..... N88-17964* #
REPT-2311107118 ..... N88-17759 #

RF-447211 ..... N88-18411 #

RPI-5-24170 ..... N88-17914 #

RPT/BB0642 ..... N88-17732* #

RRK-87-10 ..... N88-18367 #

RSMAS-TR-87-006 ..... N88-18112 #

RU-87/B1/15 ..... N88-18494 #

SAND-87-1332C ..... N88-17903 #
SAND-87-1360C ..... N88-18018 #
SAND-87-1414 ..... N88-18284 #
SAND-87-1437C ..... N88-18463 #
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